SEPTEMBER 1940—FORTY-SEVENTH YEAR

MACHINERY

THE INDUSTRIAL PRESS Publishers, 140-148 LAFAYETTE ST., NEW YORK

ANNOUNCING

GLEASON REVACYCLE

NEW mass-production machine cuts straight bevel gears faster than ever before—teeth are rough- and finish-cut in one operation with a single disc cutter—each cutter revolution completes a tooth space. Production, 11x16 combination, 5 D.P.:

70 pinions or
50 gears per hour

No. 6 REVACYCLE Completing Machine

GLEASON WORKS

Builders of Bevel Gear Machinery for Over Seventy-five Years

1000 UNIVERSITY AVENUE, ROCHESTER, N. Y., U. S. A.

ENDORSED
ACCEPTED
and
USED

*pistons
connecting rods
cylinder blocks
cylinder liners
oil-less bearings
carburetor needles
carburetor valves
magneto housings
distributor brackets
distributor cams
distributor supports
valve tappets
pump bodies
flywheels
bearing liners
crankcase covers
bearing housings
sleeve crank balls
valve guides
piston pins
carburetor bodies
gears
rocker arms
blower housings
injector bodies
fuel pump housings

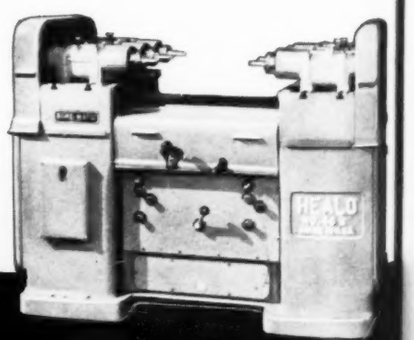
by Leading Engine Builders for PRECISION OPERATIONS

Go into most any engine plant, either aircraft, automotive, or diesel, and you'll find Heald Bore-Matics where thousandths are split thinnest. Look around these plants and you'll see an amazing variety of precision engine work being finished on Bore-Matics . . . work that runs the gamut from carburetors to blocks. Check into why practically all engine builders not only endorse and accept Bore-Matics as a production tool but use them, you'll learn that Bore-Matics give high accuracy at low cost, with far less scrap and rejections. This is why Heald Bore-Matics have been generally installed for precision finishing in the engine industry . . . and this is why if you build engines yourself it might be a good idea to get all the facts on precision finishing the Bore-Matic way. Let's get together.

*All these engine parts are borized on Heald Bore-Matics

Installation Bulletins on aircraft, automotive, and diesel engine parts gladly sent on request.

For Precision
Borize on Bore-Matics



THE HEALD MACHINE CO. WORCESTER, MASS. U. S. A.

DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

SEPTEMBER, 1940

The leading article in October MACHINERY will deal with the manufacture of gears by modern methods in a plant that produces $4,000,000 worth of industrial gears annually. Another article will describe applications of photo-electric and electronic controls in the machinery field, showing some of the unusual things that are done by the electric eye. The October number will also contain the annual condensed review of recently developed materials for the machine-building industries.

Volume 47

Number 1

PRINCIPAL CONTENTS OF THIS NUMBER

For Complete Classified Contents, See Page 180

Making Over One Hundred Tons of Die-Castings a Day . . . 101
By HERBERT CHASE

Embossing and Forming Coiled Metal Strip Stock by Rolling . . 106
By M. J. GOLDSTEIN

The Application of Carbide Tools in a Machine Tool Plant . . 111
By BYRON MERWIN

Electromagnetic Feeler-Gage Control 116

Editorial Comment 120
Industry's Part in Guiding Public Policies—Subject New Ideas to the Acid Test of Clear Thinking

"Wright Aero" Plans for Unprecedented Output 124
By P. W. BROWN

Direct Method of Designing Gears for Strength 135
By ALFRED J. NAULT

Chart for Determining Machine Production . . By L. De L. BERG 142

Extrusion Press for Stainless Steel 144

Dies for Bending Brass Channels to Rectangular and Hexagonal Shapes . . . . . By W. RICHARDS 145

Machining Heat-Treated Alloy Steels 148

DEPARTMENTS

Engineering News Flashes 118

Ingenious Mechanical Movements 121

Design of Tools and Fixtures 129

Ideas for the Shop and Drafting-Room 133

Questions and Answers 134

Materials of Industry 150

New Trade Literature 152

Shop Equipment News 155

Product Index 255-273

Advertisers Index 275-276

TOTAL DISTRIBUTION
18,261

PUBLISHED MONTHLY BY
THE INDUSTRIAL PRESS
148 Lafayette Street New York

ROBERT B. LUCHARS ..... *President*
EDGAR A. BECKER *Vice-pres. and Treasurer*
ERIK OBERG ..... *Editor*
FRANKLIN D. JONES ..... *Associate Editor*
CHARLES O. HERB ..... *Associate Editor*
FREEMAN C. DUSTON ..... *Associate Editor*

LONDON: MACHINERY, 83-113 Euston Road
PARIS: La Machine Moderne, 15 Rue Bleue

SUBSCRIPTION RATES: United States and Canada, one year, $3; two years, $5; three years, $6 (for Canada add 25 cents per year for war tax); foreign countries, $6 a year. Single copies, 35 cents. Changes in address must be received by the fifteenth of the month to be effective for the forthcoming issue. Send old as well as new address.

Copyright 1940 by The Industrial Press.
Entered as second-class mail matter, September, 1894, at the Post Office, New York, N. Y., under the Act of March 3, 1879. Printed in the United States of America. Member of A.B.P. Member of A.B.C.

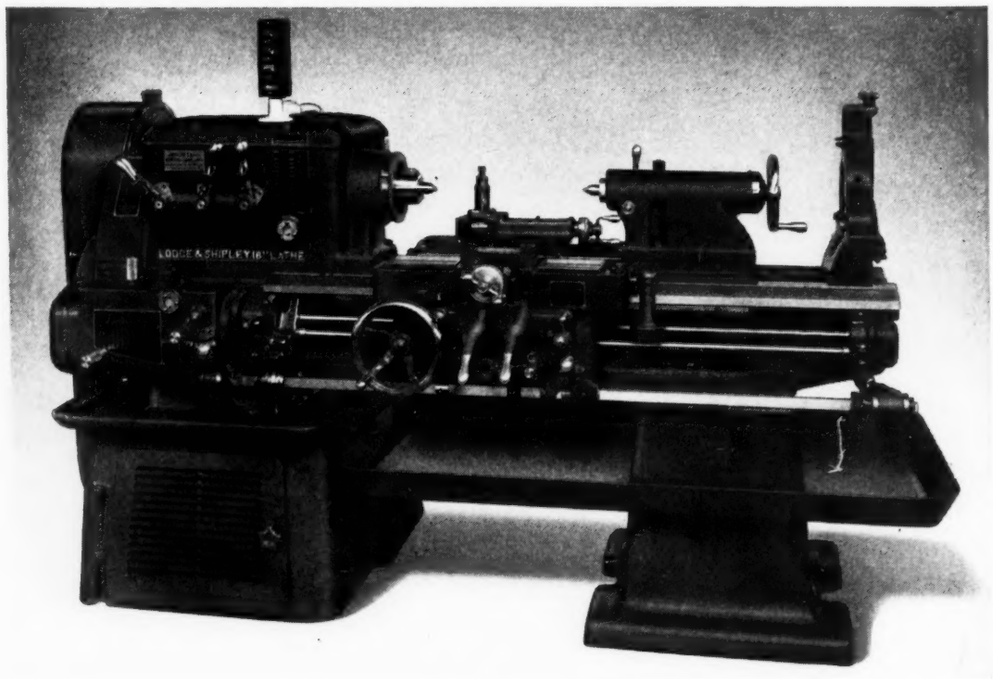
PREPARE FOR

» » » by ridding obsolescence

The ever increasing tempo that industry is being required to set is having a marked influence on the obsolescence factor in every shop today. The machine tool of a few years ago, destined for another decade of service has suddenly had its life span cut short and is being replaced by new and improved machinery capable of doing the same job in less time, with greater accuracy and at reduced costs.

Far greater demands are going to be made upon industry in the months to come and in order to fulfill these demands industry needs machine tools that will meet today's requirements without being overtaxed and still have a reservoir of production capacity for the greater demands of the future.

Lodge & Shipley Lathes are built with an eye to the future. Every detail of design reflects inherent capabilities of production at greater speed, greater accuracy, and less cost while current production records are repeatedly substantiating this reflection.

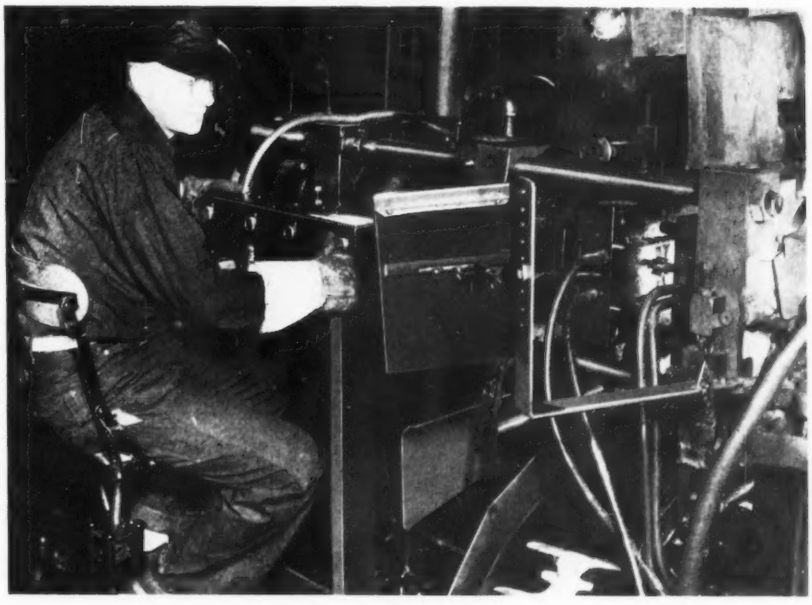


MACHINERY

Volume 47 NEW YORK, SEPTEMBER, 1940 Number 1

Making Over One Hundred Tons of Die-Castings a Day

By HERBERT CHASE

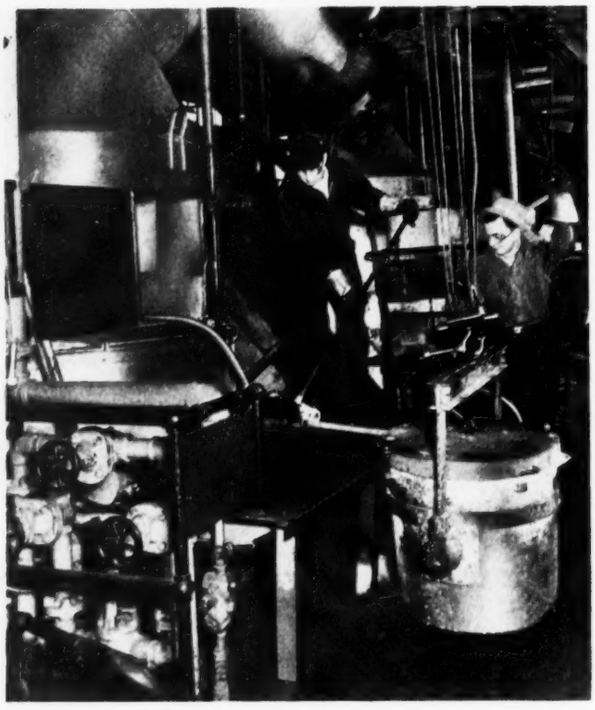


One of the Latest Semi-automatic Die-casting Machines with Push-button Controls. The Operator is Well away from the Die Parting, but the Mirror, the Back of which is Seen Close to His Right Hand, Enables Him to See into the Die when it is Open and the Casting is being Ejected into the Chute Below

At the Plant of the Ternstedt Manufacturing Division of the General Motors Corporation, 275,000 Pounds of Metal are Melted for Use in Die-Castings Every Twenty-Four Hours. This Article Describes the General Manufacturing Procedure

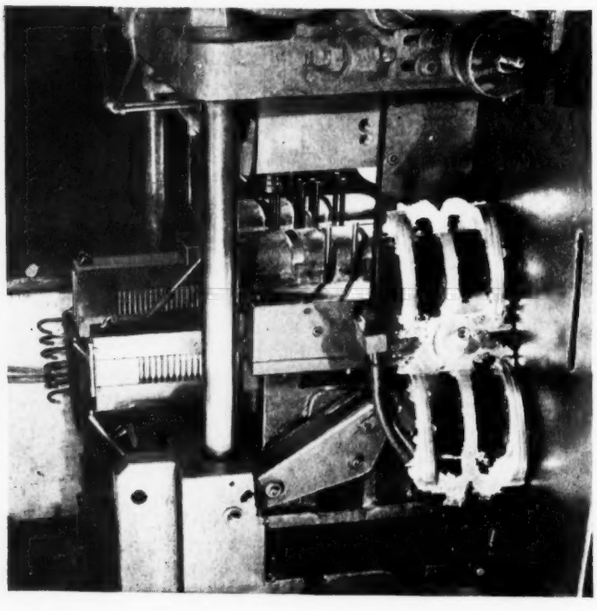
PRODUCTION of zinc alloy die-castings at a phenomenal rate has been attained this year in the Ternstedt Detroit plant No. 16, one of the numerous plants of the Fisher Body Division of the General Motors Corporation. This plant supplies the hardware and many other die-cast parts for all cars in the General Motors lines, and has the largest unit for die-casting operated by any of the corporation's subsidiaries.

It is probable that the plant melts and casts more zinc alloy per day than any plant in the world. At the time this was written, an average of 275,000 pounds of metal was melted each twenty-



One of the Furnaces in which the Zinc Alloy in Melted. Molten Metal is Syphoned from the Melting Pot into the Trolley Ladle for Transfer to the Die-casting Machines Located at a Distance from the Furnaces

Close-up View of a Die Equipped with Magazines for Automatically Feeding the Inserts around which the Shanks of Outside Door Handles are Cast. A Gate of Four Castings is Shown in the Foreground



four hours, five days a week. About 46 per cent of this was new metal, the remainder being remelted from sprues, gates, and flash removed from the castings produced and returned by conveyors to the melting furnaces. There are nine of the latter, each holding 6000 pounds of alloy; in addition, there are two tilting "hardener" furnaces, in which the copper and aluminum subsequently added to the high-purity zinc are melted. Only one alloy, commonly known as No. 5 (S A E No. 925), is produced.

Virgin metal, received at a railway siding adjacent to the casting department, is delivered direct to the furnaces on roller conveyors. Enough of the high-purity zinc slabs are weighed to secure an average weight, after which the total number of slabs for a full furnace charge is counted off and run from the conveyor directly into the furnace melting pots. Each separate heat is carefully checked for fluidity (viscosity), rate of solidification, melting point, and oxide inclusions, and test bars are cast for tensile and hardness tests and for spectrographic analysis, the last mentioned being to insure that lead, tin, and cadmium impurities are held below the extremely low limits set in the specifications for the alloy used.

Conveyors Handle Metal, Castings, and Scrap Material

The melting furnaces are located in a row across one end of the casting department. Metal is syphoned from them into a monorail ladle, with electric hoist and trolley, arranged to supply each of the forty-nine die-casting machines with molten metal. Each machine has its own melting pot, of course, to maintain, by automatic control of the burners, the metal at the required temperature for casting. All but four of the machines—the four largest ones, used for producing grilles and other large castings—are arranged along belt conveyors which run at right angles to the line of furnaces, with metal pots toward the aisles.

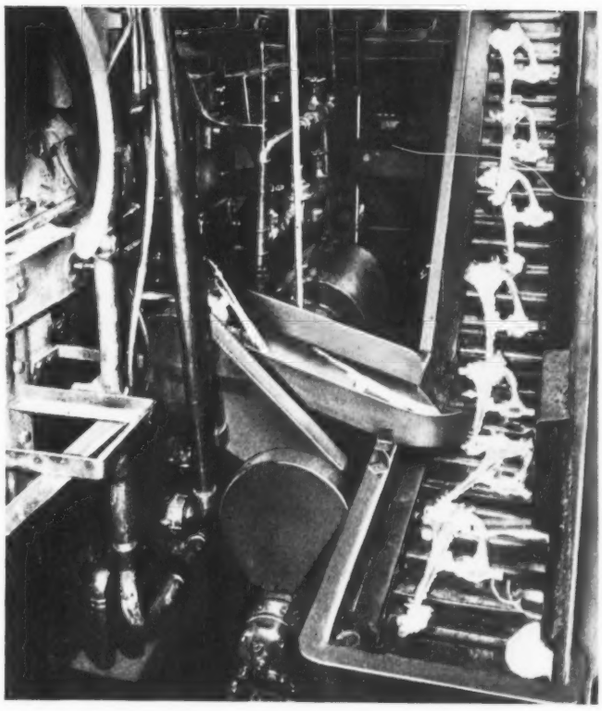
Gates of castings produced by the machines along the conveyor are first quenched in water, as they are taken or fall from the machine, and are then placed or discharged on a belt which carries the castings, still on the gate in most instances, toward the end of the conveyor. There six or more inspectors examine the castings, break them from the gates, and place the accepted ones on the carriers of a chain conveyor which meets the belts at required points. Gates and sprues, and any rejected castings that do not contain inserts, are thrown back on the return side of the belt and are carried back to the melting furnaces. Rejected castings with inserts are thrown into tote boxes, which are afterward carried to a special machine, where the castings are melted off the inserts and the latter reclaimed.

The carriers on the chain conveyors have a space for each type of casting in production. The castings are transported on the chain to machines in

other departments, where the flash is removed and any required machining is done. The castings are then passed on to polishing and buffing set-ups. A few castings, such as the Pontiac glove door, have the flash trimmed off in punch presses adjacent to the casting machine. Radiator grilles and other castings produced on the largest machines are hung on a chain conveyor, without being quenched; they cool on the conveyor as they are advanced toward the set-ups for fin removal in an adjacent room.

Smaller castings, produced along the belt conveyors, have to be quenched, so that they can be handled on the belt and by the inspectors who take them from the belt. An important innovation introduced recently on many machines along the belt conveyors is the extensive use of automatic push-outs for ejecting the castings from the die. This is not feasible in all cases, but, when used, has resulted in an increase of up to 40 per cent in the number of castings produced per hour. Some machines now run as high as 350 to 400 "shots" (die fillings) per hour, although none of the machines are small ones.

Gates of castings, upon ejection, fall either on a short belt below the die parting and then into a chute, or drop directly into a chute, down which they slide into a small quenching tank at the floor level. A short inclined link-conveyor runs from the bottom of the tank to a point above the main belt conveyor and discharges the gates of castings on the belt. Gates ejected in this manner are not handled except by the conveyors until they reach the end of the belt, where the castings are inspected as the gates are removed.



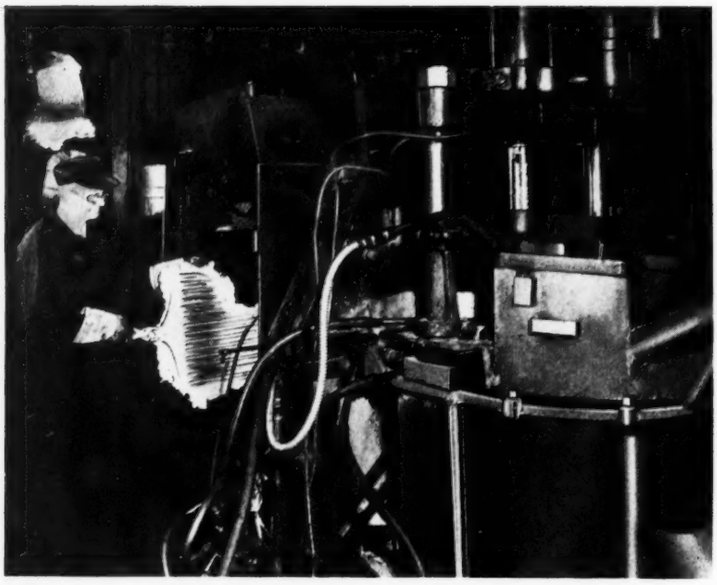
Die-casting Machine with Automatic Push-out. Castings Fall into a Chute from which They Drop into Water in the Tank at the Right, and are Carried up by an Inclined Conveyor which Drops Them on a Belt Conveyor

Operating Features of Casting Machines

Operators of machines equipped with automatic knock-outs sit at a station back of the die parting and adjacent to the controls. An adjustable mirror, set near the die parting, enables the operator to see into the die as it opens. If any flash sticks to the die or some other occurrence necessitates stopping the machine, this is done as readily and more quickly than if the operator has to step back and forth to the controls. The latter are still manual, but on the newer machines, they consist of electric buttons. The timing of the cycle is automatic after pressing the starting button. The stop-button can be pressed, of course, either to hold the die open or to stop the machine at any desired point.

Many of the die-castings produced require that inserts be cast in place. In one type of casting—an outside door handle—inserts are fed into the die automatically. In this case, the operator merely loads the inserts into a magazine attached to the die, and they are fed into place after the die has been opened and the gate of castings previ-

Inspectors near the End of the Belt Conveyor Break the Castings from the Gates and Place Them in Racks Hanging from a Chain Conveyor which Carries Them to the Finishing Departments

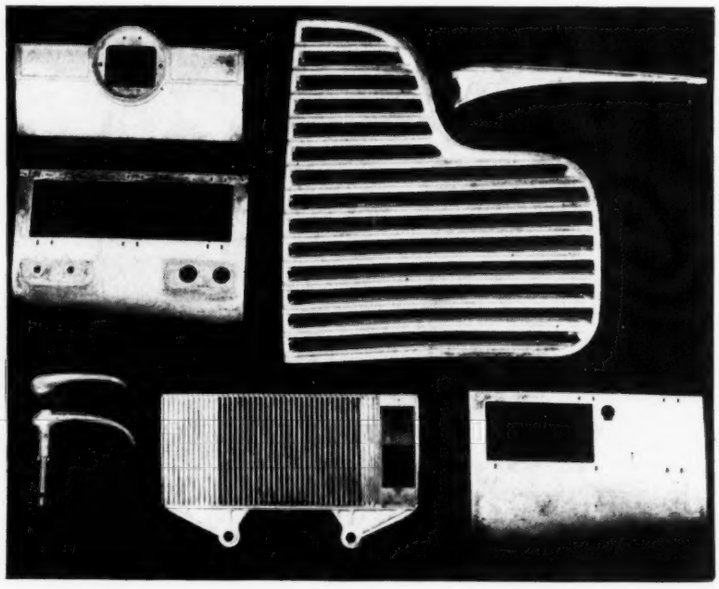


Operator Removing a Buick Radiator Grille Casting from the Large Machine in which it is Produced. The Castings are Hung on the Monorail Chain Conveyor in the Background which Carries Them to a Press, where the Flash is Sheared Off

ously made has been ejected. There are four cavities in this die and an insert is fed into each one, after which the die is closed and the shot made. In other machines for castings requiring inserts, the latter are placed in the dies by hand, which, of course, increases the length of the cycle by the amount of time required to put the inserts in place.

As this plant operates about 300 active dies, some of which are for replacement parts, and there are only forty-nine machines in which they can be made, it follows that the dies must be changed quite frequently, except on a few machines in which the requirements are sufficient to keep the dies busy continuously. As a given number of sets of parts must be shipped at stated intervals to each of the car manufacturing plants served, it is necessary to build up stocks of parts, although the total flow per day is quite uniform. No stocks are kept in the casting department, and the only tote boxes entering it are those containing inserts and a few for rejected castings having inserts cast in place. There are, however, a large number of castings on the conveyors leaving the casting department. One of these conveyors has 470 carriers, each of which holds an average of about 500 small castings. The carriers make a two-hour cycle through the trimming departments and return empty for refilling.

Rejected castings having inserts are toted to a special set-up, where they are loaded into a chain carrier having jaws that grip the steel inserts and carry the castings through gas flames. This results in melting the zinc alloy around the inserts, so that the castings fall off while the inserts continue along in the jaws and are removed before the holders return to the loading position. The inserts are then dumped into a tank of muriatic acid, which



Group of Typical Diecastings Produced in the Ternstedt Plant as They Appear after the Flash is Removed, but before Finishing

dissolves any remaining zinc alloy, and after rinsing and inspection, they are ready to be used again. The castings melted from the inserts are returned to the main melting furnaces for remelting. This keeps the inserts from entering the alloying pots where, if they were allowed to accumulate, they would gradually be dissolved in the zinc and possibly increase its iron content above the maximum allowable.

Time Studies and Records of Production Performance

To insure the efficient use of the casting machines at a high rate of production, time-study engineers, acting independently of the plant management, set up standard rates for each die, and the department is required to operate at these rates. This necessitates good coordination and a minimum of down time for changing dies, as well as the minimizing of troubles that interfere with rapid production or result in imperfect castings. Records are carefully kept and constantly checked against the standards set.

There are also records of every die, each kept on a separate card. When a die is changed, the card is sent to the machine in a transparent holder, which keeps it clean. On the card are sketches of the die showing circuits for cooling water and its temperature; the latter must be held at a predetermined point, and must be checked with a contact pyrometer to insure castings of the required quality. Set-up men follow the card record when installing a die and putting it in operation, and trouble shooters use it as a guide in locating and eliminating trouble, if any is encountered during the production run. This aids greatly in maintaining production at a high level, as well as in assuring castings of the quality and surface finish so important in automotive products.

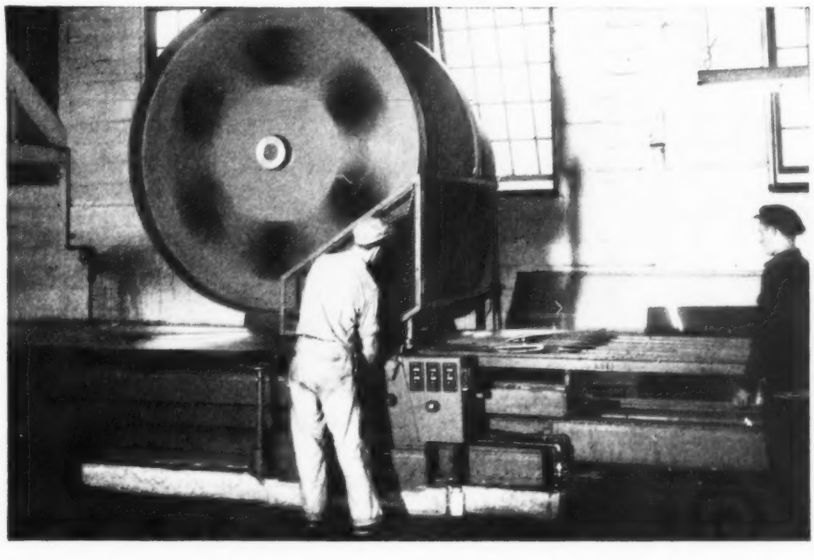
As a large proportion of the castings produced is for exposed parts which require plating, every effort is made to produce them with surfaces so smooth that such grinding and polishing as is needed is confined to parting lines. Most other surfaces are so smooth that only buffing is needed before plating. Large departments are given over to fin removal and to polishing and buffing, some of which work, including automatic buffing, will be described in a subsequent article, which will also outline the plating practice followed.

* * *

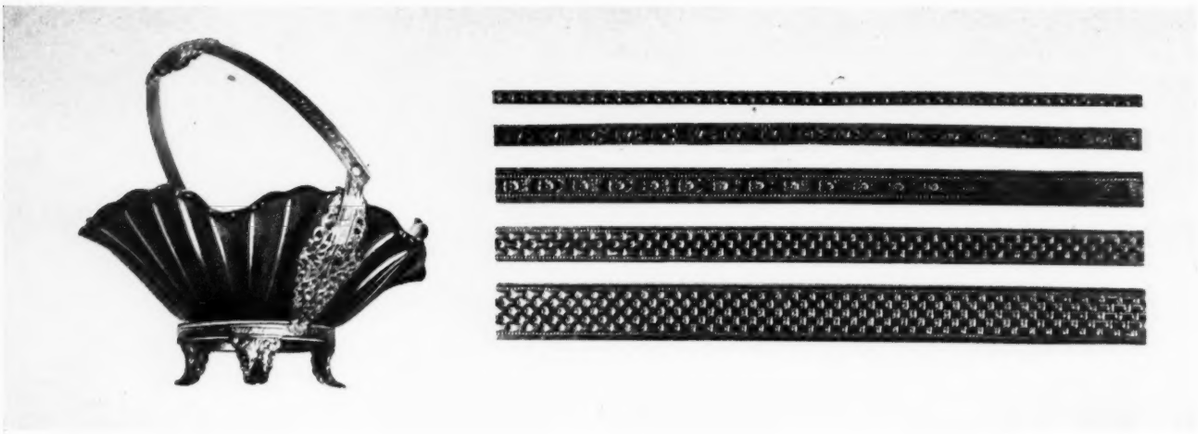
Iron-Base Alloys for Hard-Facing

In discussing a comprehensive paper on "Hard-facing" presented before the semi-annual meeting of the American Society of Mechanical Engineers in Milwaukee, Wis., by E. E. Le Van, of the Haynes Stellite Co., Kokomo, Ind., Vern E. Alden, of J. H. Manning & Co., Chicago, Ill., referred to hard-facing materials developed in the last four years—iron-base alloys containing chiefly iron, chromium, nickel, molybdenum, and carbon. The wearing qualities of these alloys, at least at temperatures up to 1350 degrees F., according to Mr. Alden, equal those of cobalt-chromium-tungsten alloys.

This family of iron-base alloys is known by the trade name "Coast Metals." Very satisfactory service life, the speaker said, has been obtained in such difficult and varied applications as pug mill knives and augers, steel rolling mill guides, coke oven pusher shoes, dies, and crushing machinery. Definite control can be exercised over these iron-base alloys to give them the required properties. Various coefficients of expansion, for example, are obtainable by slight modifications in the basic analysis; thus, cylindrical steel sections can be hard-surfaced, free from checks or cracks.



A Drum Type Grinding and Polishing Machine of Large Dimensions Recently Installed at the Plant of the Jessop Steel Co., Washington, Pa., for Finishing Sheets and Plates up to 50 Inches Wide by 14 Feet Long. While Sheets of Any Metal can be Polished, the Machine is Especially Intended for Stainless-steel and Silver-Ply Stainless-clad Sheets



Embossing and Forming Coiled Metal Strip Stock by Rolling

By M. J. GOLDSTEIN

DIES used for making ornamental stampings and "gallery" strips for use on one of the many lines of metal goods produced by a shop in which the writer was diemaking foreman, were described in December, 1938, and February, 1939, MACHINERY. Another product of this shop is the narrow metal strip stock embossed with ornamental designs shown at the right in the heading illustration, which is used on the candy dish at the left. The embossed samples include flat strips 3/16, 5/16, and 1/2 inch wide, and a half-round wire, which is 1/8 inch wide.

The machine employed for the embossing operation is known as a jeweler's roller, and is generally used in jewelry shops for reducing precious metals to the required gages. The jeweler's rollers had to be replaced with embossing rolls, engraved to produce the desired decorative effects. The rolls are set up on the shafts of the machine, as shown in Fig. 1. The upper roll is engraved with the design to be embossed on the metal.

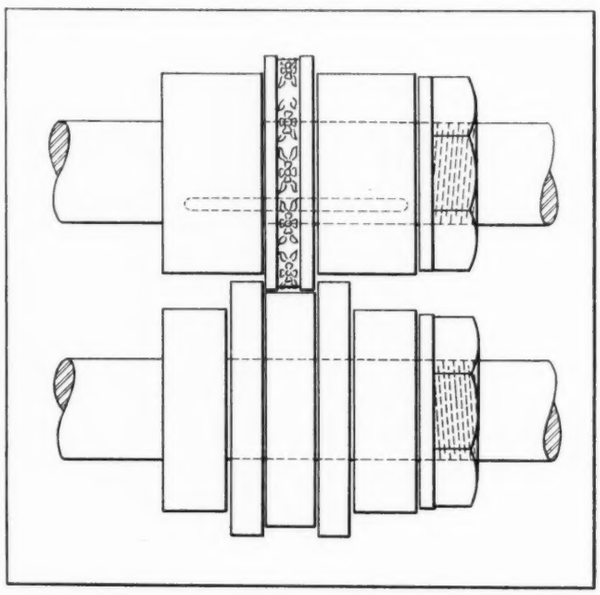


Fig. 1. Embossing Rollers for Producing Ornamental Designs on Strip Stock Such as Shown to the Right in the Heading Illustration

This roll is 2 7/8 inches in diameter and 3/4 inch wide. The design occupies a space the same width as the metal to be embossed plus a clearance space of 0.010 inch, which allows for the expansion of the metal under the rolling pressure. Without this slight clearance, the strip would become jammed in the groove. The depth of the groove is about 0.010 inch less than the thickness of the metal to be rolled.

The embossing roll is made of Ketos steel, and is hardened. It is ground all over, except on the engraved portions. The metal is lubricated by a compound that tends to keep the rolls from becoming heated excessively. The embossing rolls operate at a production speed of 38 feet per minute.

The upper or embossing roll is keyed to its shaft and serves to feed the metal through the rolls. The bottom roll is hardened and ground and has a plain cylindrical surface. It is shrouded by two hardened and ground flanges. The bottom roll is only 0.002 inch wider than

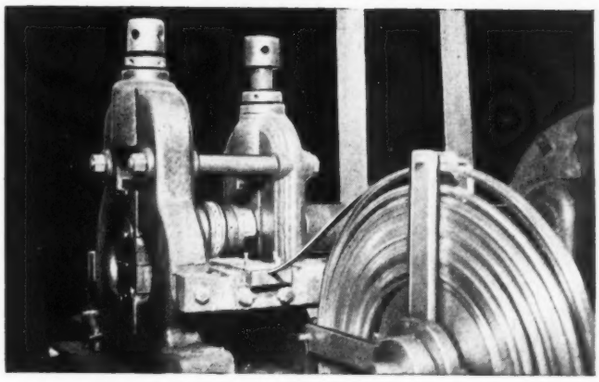


Fig. 2. Feeding the Strip Stock to Embossing Rollers from Coil Supported by Reel

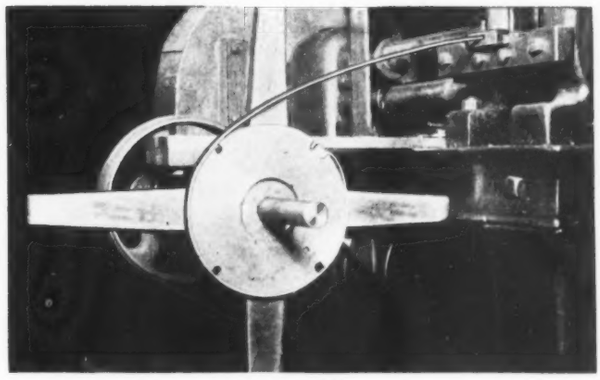


Fig. 3. Rewinding Strip Metal into a Coil as it Comes from the Embossing Rollers

the upper embossing roll, and thus keeps the engraved portion of the upper roll in accurate alignment. The rolls on both shafts are locked by right- and left-hand nuts.

The front view of the machine, Fig. 2, shows the strip metal being fed to the rolls from a coil mounted on a holder. In Fig. 3 is shown the friction winding arrangement which rewinds the embossed material into a coil. The friction arrangement of this device compensates for the increase in the winding speed as the diameter of the coil increases. Two flanges, each having four spokes, are used to confine the engraved metal as wound. The core piece has a slot for holding the end of the metal and four grooves for the wire used in tying up the finished coil. In Fig. 4 is shown the friction disk drive for the winding coil. A leather disk *A* is used between the driven pulley *B*, which is a loose running fit on the shaft, and the flange *C*, to which spring pressure is applied.

The guide through which the metal passes before entering the rolls can be seen in Fig. 2. A similar guide is located at the other side of the rolls, as indicated in Fig. 3. These guides are adjusted by set-screws, so that they guide the metal accurately in a straight line. The adjustment is a rather exacting operation. On the correct setting of these guides depends the straightness of the finished product.

In Fig. 2 can be seen the screws for adjusting the pressure exerted by the upper embossing roll. The screws are adjusted to give an even pressure and to bring out the design uniformly for the full width of the metal. The outside bearing must be subjected to more pressure than the inside one, and is, therefore, made much heavier.

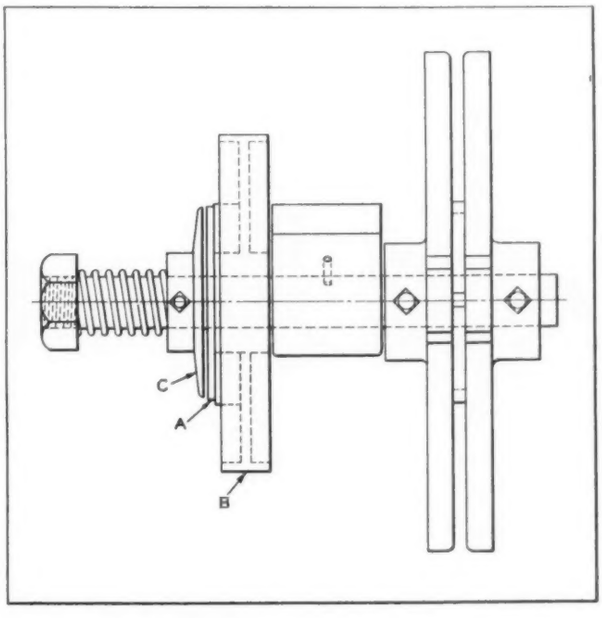


Fig. 4. Friction Driving Clutch and Stock-guiding Arms of Winding Coil Shown in Fig. 3

Fig. 5 shows a small machine built to form the embossed flat stock into circles and segments, as required. These pieces, samples of which are illustrated in Fig. 7, were previously formed by hand on tinsmith's forming rolls. The machine shown in Fig. 5 is quite simple in construction. Six rolls are driven by gearing, and the strips of embossed metal, which have previously been cut to the required length, are fed through a guide into the rolls, and at the exit point are forced against an angular shoe which forms the stock into a circle. This shoe, shown at *S* in Fig. 6, can be adjusted in or out for forming the embossed strips to any desired diameter.

At *D*, Fig. 6, is shown the method of mounting the rolls on their respective shafts. The rolls are keyed to the shafts, and held securely in place by nuts threaded to fit the shaft. It will be noted that one shaft has right-hand threads and the other left-hand threads, which prevents the rolls from becoming loose. It will also be noted that the rolling section of the upper roll enters a groove in the lower roll. This arrangement serves to guide the metal strip. The adjustable shoe *S* is shown at *E* in the proper position with respect to the last pair of rolls on the machine shown in Fig. 5. The shoe is held by a screw and dowel-pin and can be set in two different positions on its holder.

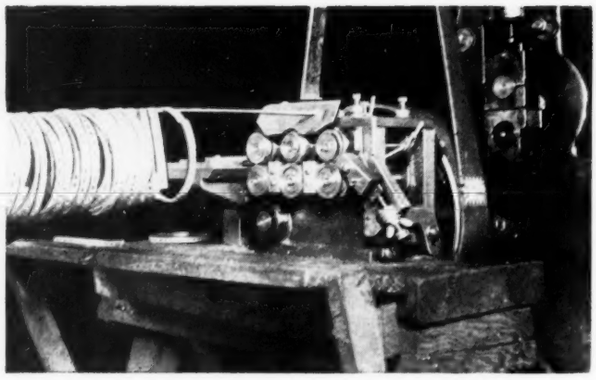


Fig. 5. Machine for Forming Embossed Strip into Segments or Rings Such as Shown in Fig. 7

The casting that holds the shoe *S* has an adjustment that permits the shoe to be set at a slight angle for forming the metal with an offset, so that the end of the circle or coil will not re-enter the rolls, but will run off at the side of the rolls onto the wire collector, as shown in Fig. 5. The coiled pieces are tied with copper wire before bright-dipping. The rolls of the forming machine are cold-rolled steel, and are pack-hardened. The shafts run in cast-iron boxes, pressure being applied by screws locked in place by nuts when properly adjusted. Oil is conducted to the bearings, which are not easily accessible, through metal tubes.

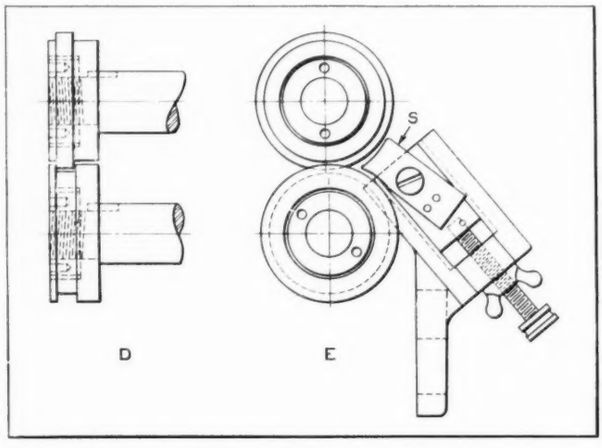


Fig. 6. Arrangement of Rollers and Shoe of Circle-forming Machine Shown in Fig. 5

One upper and lower roll would be sufficient to feed the strips, but six rolls were incorporated in the design, so that the material could be embossed previous to forming it into circles. The last pair of rolls was used for forming the work into circles, a shoe being used as previously described. The production rate on this particular part, when formed by hand, was twelve pieces per minute, compared with thirty pieces per minute when formed on the machine.

* * *

The press is the only agency capable of bringing about a re-awakening of labor, politics, and business to their mutual as well as their individual responsibilities. The press is the only effective weapon with which to combat the demagogue who seeks to stigmatize legitimate business success as a social crime.—*New York World-Telegram*

Leonardo da Vinci—Master Mind

At the New York Museum of Science and Industry, 30 Rockefeller Plaza, New York City, a most unusual display of working models of Leonardo da Vinci's inventions will be on view for the next six months. The exhibition has been loaned to the museum by the Italian Government, for whom the models were built. Some of these models are full size, while others are built to a reduced scale—all, however, are quite large.

Among the working models on exhibition are pumps and other devices for lifting water (and actually doing it); machines for dredging and digging canals; apparatus designed for experimentation and research into various basic mechanical laws; and military inventions, including cannons and what probably was the first machine gun ever conceived. There are also models of military fortifications and buildings, as well as designs for city planning (which, by the way, can be favorably compared with the most advanced ideas of present-day city planners), etc.

Leonardo's "flying machines" and instruments for the study of aerodynamics are shown. The exhibit also shows typical selections of his work in anatomy, astronomy, botany, geology, and mathematics, as well as numerous sketches and drawings showing his talent as an artist.

Leonardo was born in Vinci, Tuscany, in 1452 and died at Colux, France, in 1519. Besides his few major works of art, which include the *Mona Lisa* and the *Last Supper*, the record of his achievements consists of some 7000 sheets covered with drawings and notes. Apparently, nothing that came within the range of his faculties was alien to him.

Fig. 7. Examples of Embossed Strip Stock Formed into Circles and Segments

The Application of Carbide Tools in a Machine Tool Plant

Recommended Types of Tools, Speeds, Feeds, and Depths of Cut for Machining Different Kinds of Materials with Cemented Carbide, as Based on the Practice of the Bullard Co.—Second of Two Articles

By BYRON MERWIN, Manager, Standards Department
Bullard Co., Bridgeport, Conn.

MAXIMUM machining efficiency and production economy are attained with cemented carbide only when the type of tool selected is suited to the job, and the correct speed, feed and depth of cut are employed. From its extensive experience in the use of cemented-carbide tools, the Bullard Co., Bridgeport, Conn., has formulated a general practice for the efficient application of this metal-cutting material, as outlined in this and the preceding article in August MACHINERY, page 105.

In using cemented-carbide tools for general work on steel where the cut is continuous, a feed of 0.010 to 0.042 inch can be employed, the average feed being 0.018 inch per revolution. A cutting speed of 200 to 350 feet per minute is used with a depth of cut of 1/16 to 3/4 inch, 1/4 inch being the average depth.

Outstanding examples of machining operations performed with cemented-carbide tools are shown diagrammatically in Fig. 1.

A piece of S A E 3250 steel, shown at *A*, Fig. 1, is turned by using two cemented-carbide tools such as the one shown in Fig. 3, which are used simultaneously on a 30-inch vertical turret lathe. The cut indicated as No. 1 is taken by the tool held in the side-head of the lathe, while the cut indicated as No. 2 is taken by the tool held in the main head of the machine. The cutting speed at point *S* is 200 feet per minute and the feed is 0.015 inch per revolution. The average amount of material removed per minute is 32 cubic inches.

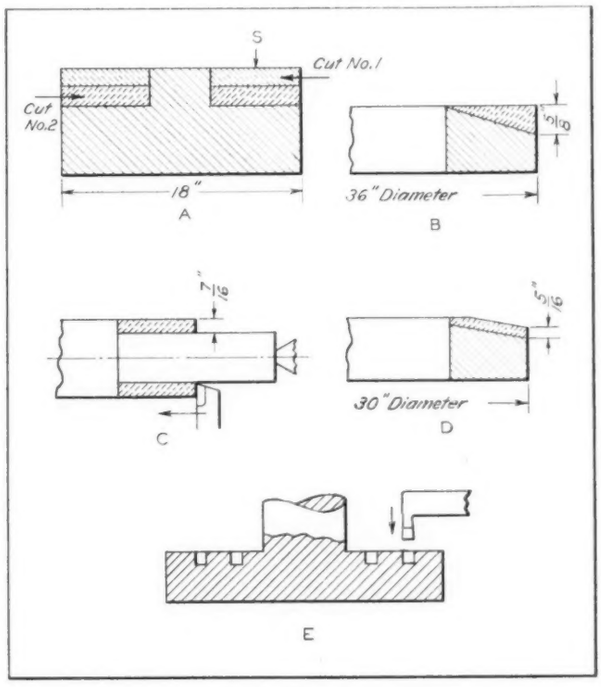


Fig. 1. Diagrams Showing Examples of Operations Performed with Cemented-carbide Tools

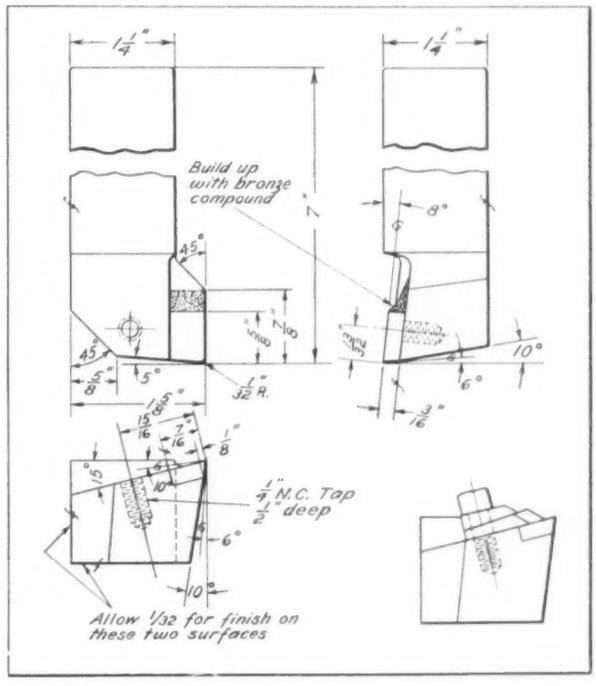


Fig. 2. Right-hand Steel-turning Tool with Cast-iron Shank and Cemented-carbide Tip

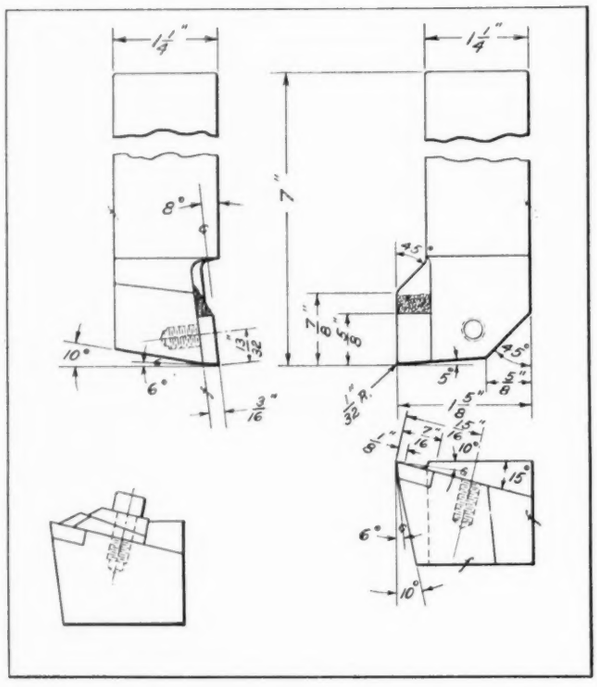


Fig. 3. Left-hand Steel-turning Tool with Chip Breaker Shown in the Lower Left Corner

Another example of a piece of work handled on a 42-inch vertical turret lathe is shown at *B*. This material is S A E 1045 steel and is machined at a speed of 225 feet per minute with a feed of 0.032 inch per revolution. A tool such as shown in Fig. 3 is used for this operation.

A piece of S A E 3250 round bar stock, as indicated at *C*, Fig. 1, is machined at a surface speed of 200 feet per minute with a feed of 0.021 inch per revolution. For this operation a tool such as shown in Fig. 2 is employed.

At *D*, Fig. 1, is indicated a machining operation performed on a 42-inch vertical turret lathe, using a tool such as the one shown in Fig. 3. The material in this case is S A E 4640 steel. The work is turned at a speed equivalent to 225 surface feet per minute on the outside diameter. The feed employed for this operation is 0.042 inch per revolution of the work.

At *E*, Fig. 1, is indicated a machining operation performed on a 30-inch vertical turret lathe. This consists of cutting grooves in S A E 1045 steel with a right-hand grooving tool such as seen in Fig. 6. In this case the width of the cut is 3/8 inch. The cutting speed is at the rate of 200 feet per minute and the feed 0.018 inch per revolution.

Design of Turning Tool Used for General Turning Operations on Steel

The form or design of the cemented-carbide tool adopted at the Bullard plant for general turning operations on steel work is shown in Figs. 2 and 3, the tool in Fig. 2 being right-hand and the one in Fig. 3 of the left-hand type. The cutting edge of this tool, being offset, permits turning operations close to jaws, table, shoulders, etc. The offset also facilitates grinding the tool. The 15-degree top side rake with a 10-degree land 1/16 inch wide also facilitates grinding and serves to give the tool a longer life. The back rake is 8 degrees and there is a front and a side clearance of 6 degrees.

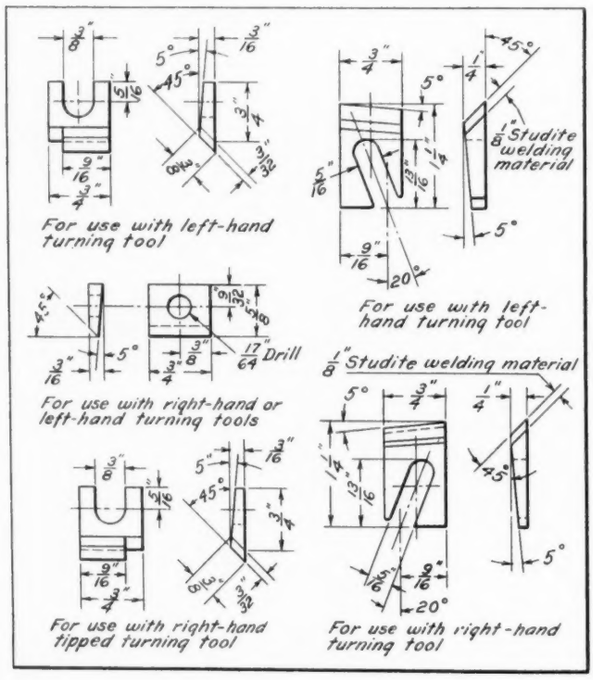

For use with left-hand turning tool
For use with left-hand turning tool
1/8" Studite welding material
For use with right-hand or left-hand turning tools
17/64" Drill
1/8" Studite welding material
For use with right-hand tipped turning tool
For use with right-hand turning tool

Fig. 4. Design of Chip Breaker in Lower Right and Left Corners, Respectively, of Figs. 2 and 3

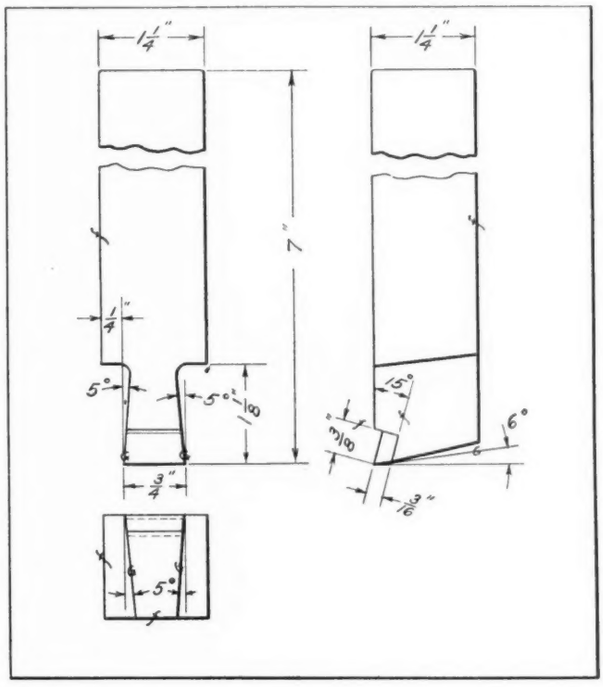


Fig. 5. Shovel Nose Type Tool with Cemented-carbide Tip Employed for Cutting Steel

At the Bullard plant, a Carboloy tip of grade 78A or 78B is used, brazed to the shank. Kennametal tips of grade KM are also employed in the same manner. Tools of this design are employed for all turning operations in both boring mills and lathes.

A mechanical chip breaker of the design shown in Fig. 4 is used to curl and stress the chip to the point of breakage. This chip breaker can readily be adjusted to change the distance between the breaker face and the cutting edge of the tool to take care of the various depths of cuts and feeds. Without the chip breaker, a straight ribbon chip will be produced which would be dangerous to the operator and very difficult to handle.

The cast-iron shanks of the tools seen in Figs. 2, 3, 5, and 6 are made of nickel-chromium-molybdenum iron. These shanks are designed to resist deformation under the tungsten-carbide tips, and have high heat conductivity and a low coefficient of expansion. The tip is made with as small a radius as possible, preferably 1/32 inch. The standard tip size adopted for these tools is 5/8 by 7/16 by 3/16 inch.

Machining Steel Parts When Cut is Interrupted

Interrupted cuts not over 1/4 inch deep are taken at a speed of 150 to 200 feet per minute with a feed of 0.010 to 0.015 inch per revolution, using a cemented-carbide tool with a negative back rake of approximately 3 degrees, a positive side rake of from 0 to 6 degrees, and a front and a side clearance of 4 to 6 degrees. For special machining work, a mechanical chip breaker is usually unnecessary, a ground step being provided on the tool when required.

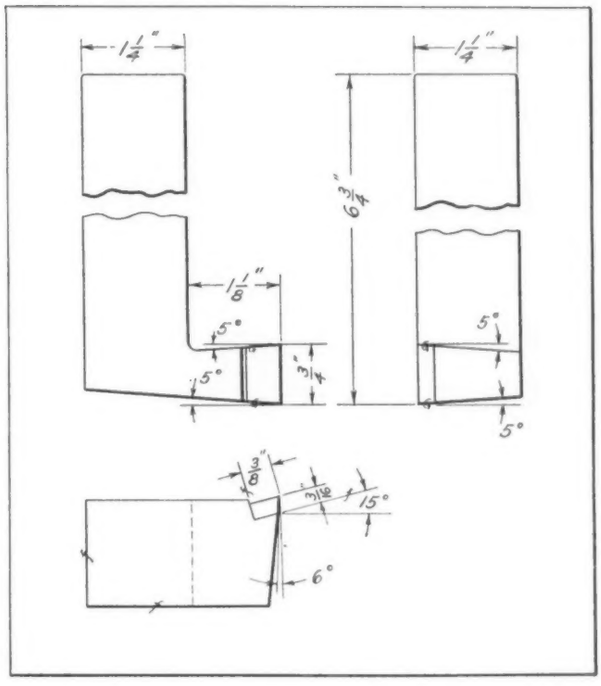


Fig. 6. Cemented-carbide Tipped Grooving Tool Used for Cutting Steel

Examples of interrupted-cut work include turning operations over the ends of the teeth of a spur gear. In machining a gear in this manner, made from S A E 3250 steel, a depth of cut of 1/16 inch has been successfully employed at a speed of 175

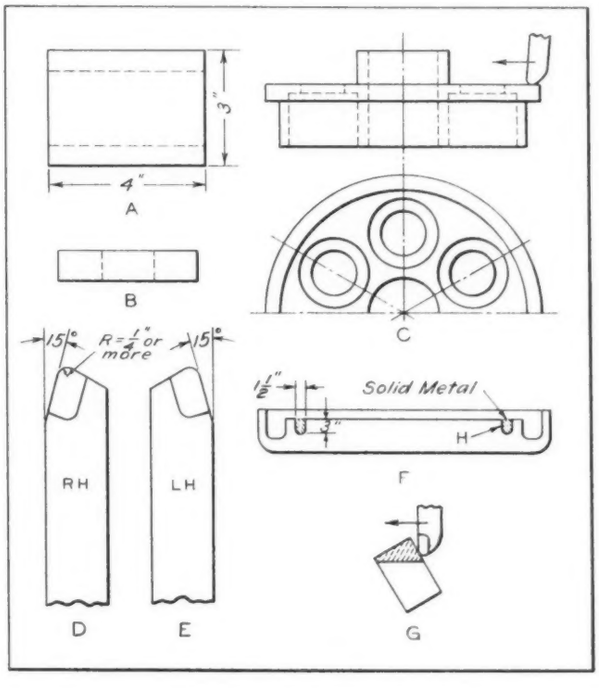


Fig. 7. Examples of Cast-iron and Non-ferrous Work, and Tools Employed

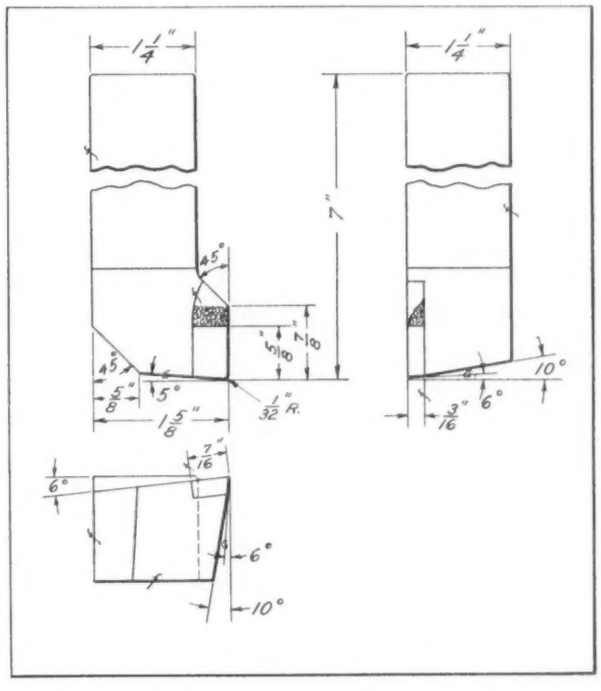


Fig. 8. Right-hand Turning Tool for Machining Cast-iron and Non-ferrous Metals

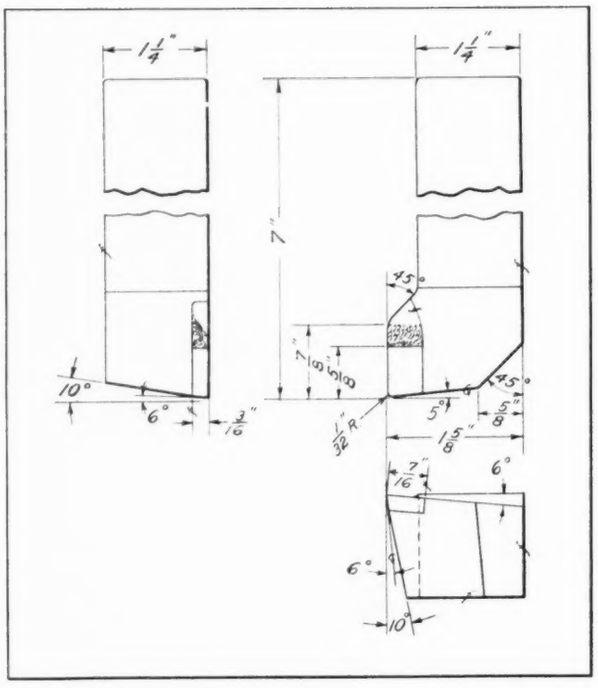


Fig. 9. Left-hand Turning Tool Designed as Companion for Right-hand Tool in Fig. 8

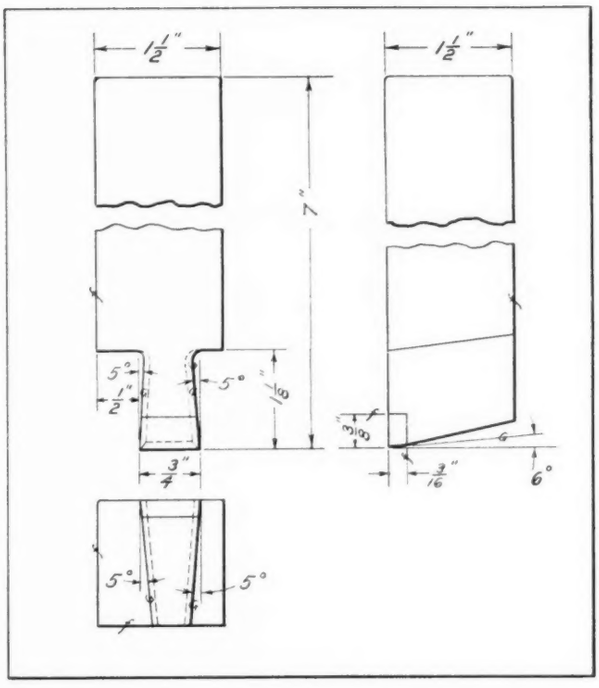


Fig. 10. Cemented-carbide Tip Shovel-nose Tool for Machining Cast Iron

feet per minute, with a feed of 0.015 inch per revolution. In another case, a piece of work with six splines, made from S A E 3250 steel and heat-treated to a scleroscope hardness of 60 to 65, is turned on a lathe at a speed of 80 feet per minute with a feed of 0.015 inch per revolution, the depth of the cut being 1/16 inch.

The shovel nose type tool shown in Fig. 5 and grooving tools such as the one illustrated in Fig. 6 are employed for cutting steel at a speed of 200 to 350 feet per minute with a feed of 0.002 to 0.015 inch per revolution. The depth of cut employed with these tools ranges from 1/8 to 1 inch. Tools of this design usually have the tip set in on a 15-degree back rake angle with a 6-degree front clearance.

Tools, Speeds and Feeds for Machining Cast-Iron and Non-Ferrous Metals

For continuous turning operations on cast-iron and non-ferrous metals, cemented-carbide tools are used with feeds up to 0.065 inch per revolution, cutting speeds of from 200 to 500 feet per minute, and for cuts from 1/8 to 3/4 inch deep. The turning tools adopted by the Bullard Co. as standard for this work are designed as shown in Figs. 8 and 9. It will be noted that these tools have offsets, the same as those used for steel. However, the top side rake is 6 degrees; there is no back rake and the front and side clearances are from 4 to 6 degrees. The same type shanks are used for these tools as for the ones employed for steel.

For interrupted cuts up to 3/4 inch deep at cutting speeds of 150 to 300 feet per minute, feeds up to 0.050 inch per revolution are employed with tools ground to the shape shown at *D* and *E*, Fig. 7. These tools have the cutting side ground at an angle of 15 degrees to the face of the work. The top side rake is 6 degrees and there is no back rake. The end is ground to a radius of 1/4 inch or larger, giving the tip a negative rake.

Cemented-carbide tip shovel-nose, parting, and hook type tools are made with the cemented-carbide tip set parallel with the top and bottom faces of the holder with no rake, as indicated in Fig. 10. The same clearance angles are used as for the steel-cutting tools. Planer tools tipped with cemented-carbide bits have a 5-degree side rake, a 5-degree negative front rake, and a radius of 1/4 inch or larger. These tools are used at a cutting speed of 80 feet per minute and with feeds up to 1/8 inch, and cutting depths up to 3/4 inch.

Milling cutters with inserted cemented-carbide blades can be used for chip loads up to 0.010 inch per tooth at cutting speeds of 150 to 200 feet per minute and at cutting depths up to 1/2 inch. The blades of these cutters are set back of the center line to give a positive rake.

Continuous turning operations on bronze bushings such as shown at *A*, Fig. 7, are performed on a lathe using a tool of the design shown in Fig. 8. For this work the depth of cut is 1/8 inch, the feed 0.030 inch per revolution, and the surface cutting speed 300 to 500 feet per minute.

In facing and turning lower bearing retainers, such as shown at *B*, Fig. 7, on a 24-inch vertical turret lathe, tools of the design shown in Figs. 8 and 9 are employed. The material in this case is cast iron having chilled spots. The depth of cut

used in facing and turning is 1/4 inch, the feed 0.030 inch per revolution, and the speed from 150 to 200 feet per minute.

Interrupted facing cuts are taken on a cast-iron carrier 16 inches in diameter, shown at *C*, Fig. 7, on a 64-inch vertical turret lathe equipped with a tool such as shown at *E*. Referring to the illustration it will be noted that there are six holes in the carrier, making six interruptions of the cut per revolution of the work. Cuts as deep as 3/4 inch are taken on the face of the carrier, with a feed of 0.040 inch per revolution at a surface cutting speed of 200 feet per minute.

The annular slot or groove *H* in the cast-iron chip trough shown at *F*, Fig. 7, is cut out of the solid metal with two tools mounted on a 100-inch vertical boring mill. The tool which takes the first chip is 3/4 inch wide, while the second tool brings the groove to the required width of 1 1/2 inches. This operation is performed at a cutting speed of 150 feet per minute with a feed of 0.008 inch.

Cemented-carbide planer tools are employed as shown at *G*, Fig. 7, for machining column gibs that have been heat-treated to a Brinell hardness of 290. The depth of cut used for this work ranges up to 1/2 inch, using a feed of 1/16 inch and a speed of 40 feet per minute.

Milling cutters with cemented-carbide inserts are also employed on planer type milling machines for machining cast-iron vertical turret lathe beds. Face-milling cutters 10 inches in diameter with 18 teeth are used for this work, cuts being taken the full width of the teeth. These cutters are run at a speed of 63 revolutions per minute and take cuts 3/8 inch deep with a feed of 10 inches per minute. The surface cutting speed is 165 feet per minute and the chip load per tooth 0.009 inch.

Industrial Moving Picture Available

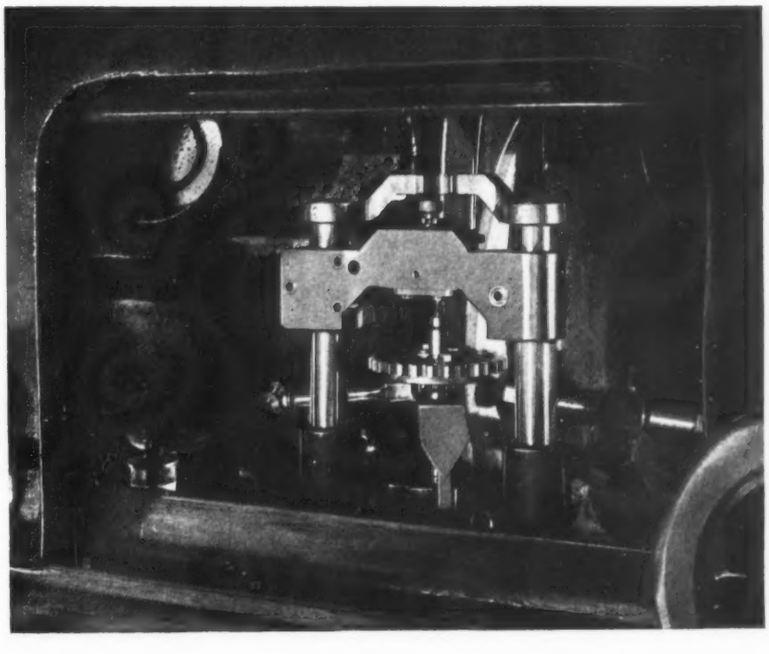
A new sound motion picture has been produced by the du Pont company telling the story of Neoprene, a synthetic rubber-like material which is being used to replace natural rubber in a great many industrial applications. The picture is available without charge to any organization that wishes to make use of it, by addressing the Rubber Chemicals Division, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. It is made for a 16-millimeter sound projector.

A most interesting thing about Neoprene is that it is made from materials of which there are unlimited supplies—coal, limestone, salt, and water. It can be used wherever rubber is used, but has the additional advantage of being resistant to cracking from sunlight, ozone, and aging. Among the products made from Neoprene may be mentioned transmission and conveyor belting; gaskets, seals, and packing; pistons and valves; etc.

* * *

Western Metal Congress and Exposition

The fourth Western Metal Congress and Exposition, sponsored by the American Society for Metals, 7301 Euclid Ave., Cleveland, Ohio, will be held May 19 to 23, 1941, at Los Angeles, Calif. The previous meetings and expositions held under the auspices of this Society were in 1929, 1931, and 1938. The exposition will be held in the Pan American Auditorium, the same as formerly. A number of technical societies will participate in the Congress, which will have headquarters at the Biltmore Hotel.



Lees-Bradner Gear-tooth Grinding Machine Finishing Gears for Airplane Engines in the Factory of the Pratt & Whitney Aircraft Division of the United Aircraft Corporation at East Hartford

Electromagnetic Feeler-Gage Control

How Die-Sinking Operations May be Controlled Automatically—Second of a Series of Articles

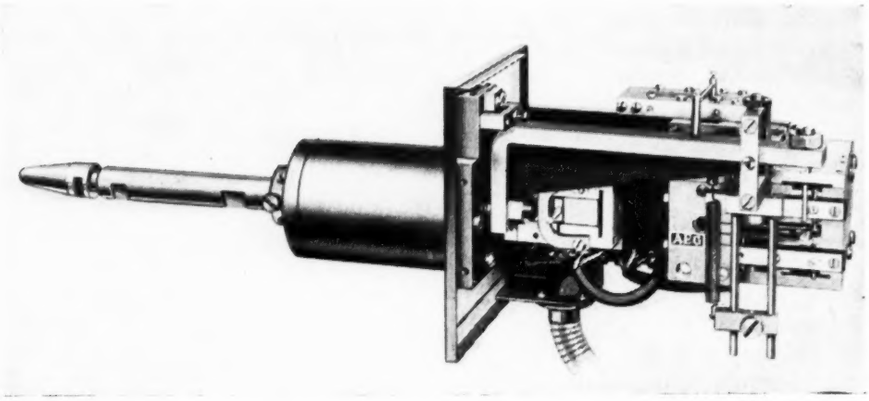


Fig. 5. Feeler with Three Built-in Gage Heads for Contour Following in Horizontal, Vertical and Axial Directions

THE use of an electromagnetic gage for inspection measurements of small parts and the automatic control of a grinding machine were referred to in August MACHINERY, page 119. The present article will describe the application of a similar device to the automatic control of die-sinking operations.

Where the control of cutting tools must be effected in three dimensions, a feeler with three built-in gage heads (Fig. 5) for recording deflections in horizontal, vertical, and axial directions is used. A high degree of sensitivity and flexibility is obtained by the swivel mounting of the feeler in a diaphragm. Because of the precision of the gage heads and the quick and accurate functioning of the electronic relays, several relays can be operated even with only small deflections of the feeler. With this arrangement, the electronic relays associated with each gage head are operated in correspondence with the magnitude of deflection of the feeler pin, thereby controlling the cutting tool.

When applied to an automatic die-sinking machine, the electronic tubes actuate secondary relays which, in turn, select the proper machine tool controls, such as the automatic reversing switches of the three feed motors.

The accuracy of the die-sinking operation depends not only upon the sensitivity of the electronic tubes, but also upon the quick action of the secondary relays and control switches, as well as rapid braking of the motors. The latter is accomplished without the aid of the usual rotary magnetic clutches by an instantaneous short circuiting braking system.

The relays are of the quick-acting type which respond within a few milliseconds. For high-frequency switching, platinum contacts are provided in the place of tungsten for the small relays, and sparking is prevented by bridging the contacts with small condensers. The small relay in Fig. 6 has a time constant of 0.003 second and the intermediate relay operates within 0.008 second. The time constant of the automatic switches is considerably reduced by means of steadying resistances, and their coils are operated by excess voltage when switched on.

The feeler gage can be adjusted for three different stages, depending upon whether roughing, medium or fine finishing cuts are to be taken. Control of the gage movement is effected by means of the regulator in such a way that the speed of one of the feed motors increases while that of the other decreases. The regulator resistances are so arranged that a sinusoidal change in motor speeds is produced, giving a constant feed.

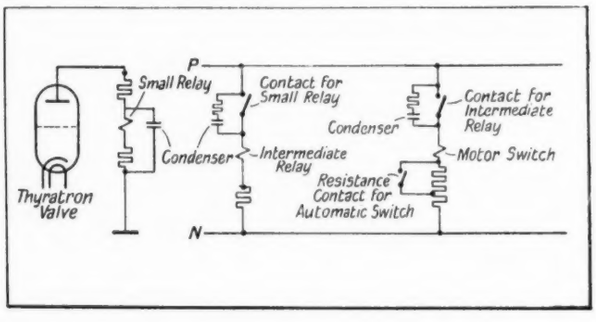


Fig. 6. Circuit Connections for Relays and Automatic Switches Used in Conjunction with Feeler

In Fig. 7, the range of sinusoidal control of the horizontal and in-feed motors, which

have a speed range of 200 to 2000 R.P.M., is shown. Within the maximum and minimum limits, indicated by R_1 and R_2, respectively, a constant feed rate can be obtained in various directions, represented by diagonals from the zero axis, with the corresponding motor speeds indicated by the respective vertical and horizontal scales. Within angle a, which represents the difference between γ and β, lies the range of angles on the master which can be traced steplessly.

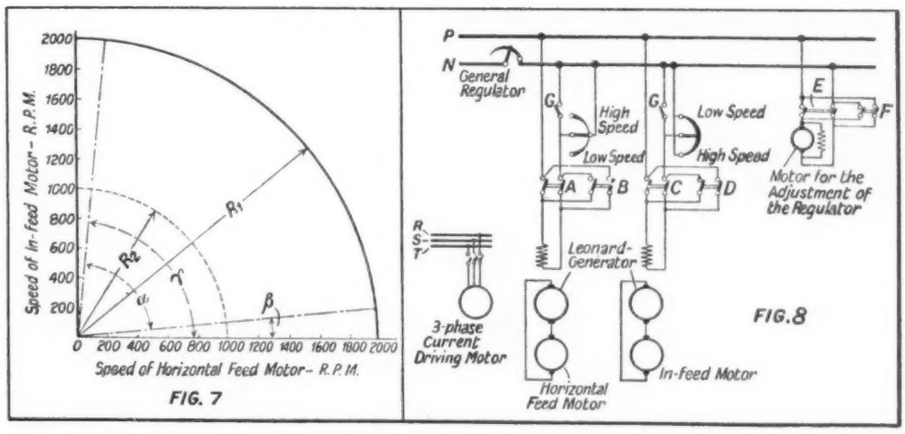


Fig. 7. Constant Rate of Feed, Regardless of Change in Direction, is Obtained by Sinusoidal Control of Horizontal and In-feed Motors. Fig. 8. Circuit Diagram for Horizontal Feed and In-feed Motors on Automatic Die-sinking Machine

As shown in Fig. 8, a separate generator is provided for each of the feed motors and both generators are driven by a common three-phase motor. The field circuits of the generators are controlled by automatic motor switches *A*, *B*, *C*, and *D* in conjunction with regulators which are coupled together and driven by a common auxiliary motor. The arrangement is such that while one motor runs at its highest speed the other is stopped entirely, and as the regulator arm is advanced the second motor starts while the first slows down, so that the resultant speed is in accordance with the diagram shown in Fig. 7. The auxiliary driving motor can be switched in and out by the automatic switches *E* and *F*, Fig. 8, which also serve for reversing the direction of rotation.

The feeler-control system is so arranged that the auxiliary motor is switched on for clockwise rotation of the regulator set whenever the feeler pin is clear of the master, thus causing the pin to advance toward it. Similarly, the regulator set is rotating in a counter-clockwise direction whenever the feeler pin is moved away from the master. If the feeler pin traces a surface in the horizontal direction with the arm of the regulator set in a corresponding horizontal position, the armature of the in-feed gage head is deflected from its rest position to position T_1, seen in view *a*, Fig. 9.

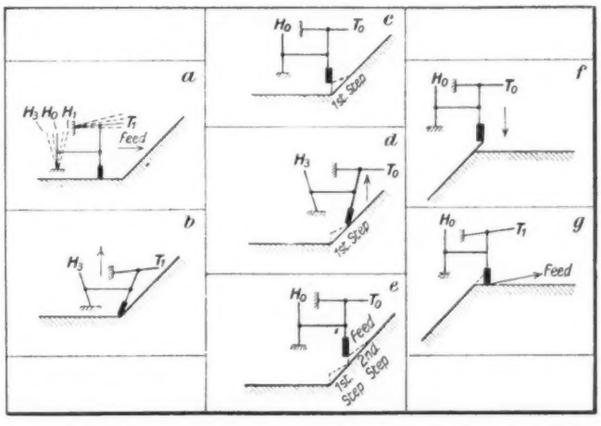


Fig. 9. Steps Taken in Adjustment of Feeler to Changes in Contour Slope

If the feeler pin strikes a projection on the master, the armature of the horizontal gage head is deflected from its central position H_0 to the position H_3, as seen in the view *b*, so that the horizontal feed movement is stopped. Simultaneously, full voltage is applied to the generator field of the in-feed motor, which runs at full speed and thus withdraws the feeler from the master. At the same time the auxiliary motor rotates the regulator set counter-clockwise. As the withdrawal of the feeler is interrupted, the switch is released, and the rotation of the regulator set stops.

The feeler then moves in the new direction determined by the regulators, which, initially, does not conform to the direction of the curve being traced (diagram *c*). Then subsequent movements of the regulators, such as those described, take place, as shown at *d* and *e*, so that the cutter is fed across the work in corresponding steps until the final resultant movement of the feeler conforms to the actual slope of the master. The feeler then follows the contour of the master, while the in-feed gage head is deflected to the position T_1.

If the slope of the master decreases, the feeler leaves the surface, the gage head again returning to the position T_0, in which the resultant movement is interrupted, as seen in the view *f*. The feeler is then advanced toward the master and, simultaneously, the automatic switch *F*, Fig. 8, is operated, causing the regulator set to be rotated in a clockwise direction. Thus, the direction of the feeler movement is changed accordingly. This new movement, however, does not start until the feeler again contacts with the master and the armature of the in-feed gage head is in the position T_1, as seen in the view *g*, Fig. 9. If the resultant direction of the feeler movement does not conform to the slope of the contour, subsequent regulation takes place, as previously explained.

Engineering News Flashes

The World Over

Millionth-of-a-Second Radiographs Made by New X-Ray Tube

A new cold-cathode, ultra high-speed X-ray tube that makes millionth-of-a-second radiographic exposures has been developed by the Westinghouse Lamp Division's research laboratories at Bloomfield, N. J. It is believed that the development of this tube will extend the usefulness of the X-ray. It may make possible X-ray motion pictures and facilitate the study of internal strains in rapidly moving parts of machinery. By its means it may be possible to literally look into rapidly moving opaque objects and study the effect of sudden forces on such objects. In laboratory experiments, the research engineers took millionth-of-a-second radiographs of moving bullets, golf balls being driven from a tee, baseballs being batted, and numerous other objects.

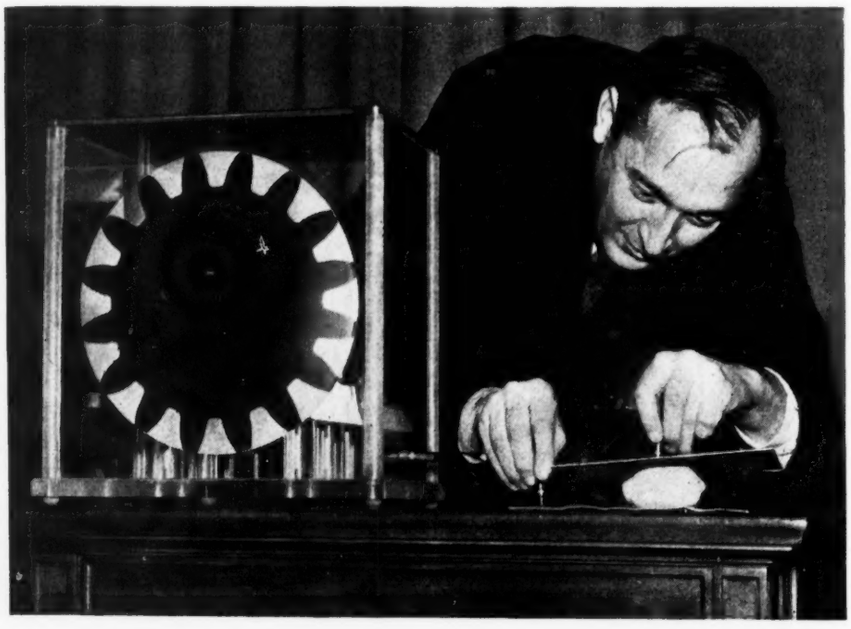
A Tension Test in Progress for Eleven Years

A single tension test on stainless steel that has been in progress in England for eleven years is mentioned in the *Electromet Review*, published by the Electro Metallurgical Co., 30 E. 42nd St., New York City. Over a decade ago, the ability of austenitic stainless steel to withstand medium loads for long periods of time without flowing or becoming deformed was questioned. An actual test was suggested. A strip of cold-worked, chromium-nickel stainless steel was subjected to a stress of 56,000 pounds per square inch. Measurements for possible stretch were taken month after month.

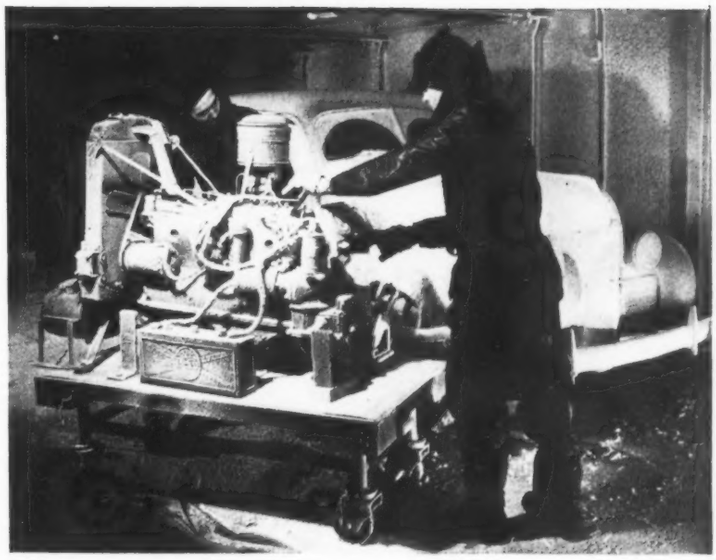
Recently it was announced that little, if any, stretch could be noticed after eleven years. Based on the tests, it is stated that a 10-foot length of this steel placed under a load of 56,000 pounds per square inch for twenty years would have a total increase in length of less than 0.001 inch.

New Bearing Introduced by Buick

The Buick Motor Division of the General Motors Corporation has completed tests and will shortly place in production an entirely new type of steel-backed, high-lead, babbitt precision bearing which, it is claimed, will increase engine bearing life over 200 per cent, and which is said to represent an



In the General Electric "House of Magic" at the New York World's Fair, power for running a miniature electric motor is obtained from an ordinary lemon. The illustration shows a whole lemon being used, but thin lemon slices work best. They are placed between sheets of copper and zinc, with which the acid of the lemon forms an electrical cell, similar to a dry battery, producing enough electric current to operate a small motor.



The laboratory testing equipment of the Oldsmobile plant at Lansing, Mich., includes a "cold room" or giant refrigerating chamber in which every phase of engine performance can be studied under sub-zero conditions. Cars are tested exhaustively in this cold research room in order to work toward obtaining maximum starting characteristics. Carburetion and the electrical system also receive close scrutiny for functional ability.

outstanding advance in engine development. The new bearing has unique metallurgical qualities, but is costlier in construction than the bearings ordinarily used in automobile manufacture. It was made to withstand the exacting operating conditions due to high compression ratios, greatly increased power output per cubic inch of displacement, high crankshaft speeds, and high piston pressures. The bearing is said to approach airplane engine practice in its ability to meet these requirements.

Briefly, the new bearing has, first, a sponge-like matrix which has an affinity for the steel backing and becomes a permanent part of it, and, second, an extremely thin layer of the bearing material, securely bonded and mechanically locked to the matrix. The bearings are known by the trade name "Durex No. 100."

Electrolimit Gage Insures Paper of Uniform Thickness

Precision has done much to improve the art of printing. More accurate printing presses, better engravings, and accuracy of type all play their part. It remained for the paper manufacturer to produce a product of uniform and accurate thickness. By the use of a Pratt & Whitney Electrolimit paper gage, precision in paper manufacturing is made possible. The gage is applied to the last rolls of a paper machine. It gives a continuous reading of paper thickness to 0.0001 inch.

The attendant is able to read off the thickness of the paper at all times while the machine is in motion; it is a simple matter for him to so adjust the machine that paper of uniform thickness will be produced. Whenever the paper is not running to the correct thickness, this difficulty can be detected instantly. The gage can be applied wherever paper is passing over a roll, at any stage of the production. It can also be used with an automatic recorder, which produces a permanent record of the thickness of every foot of paper in a roll.

Electrolimit gages have been used for some time for producing accurate thicknesses of sheet metal in continuous sheet mills. The same principle is now applied to the production of paper of uniform thickness. The gage can be applied to paper thicknesses varying from 0.003 to 0.030 inch.

Ford Built One Submarine Chaser a Day in Last World War

In commenting on Henry Ford's statement that he could build one thousand planes a day, attention has been called to the fact that in the last war he built more than one hundred submarine chasers, each of 25 1/2-foot beam, 200 feet long, weighing 200 tons, by methods paralleling those that he had found so highly successful in the mass production of automobiles. The building of these submarine chasers became one of the greatest industrial achievements during that war.

A series of buildings and structures erected at River Rouge, Mich., provided for the fabrication of the steel ships; the progressive assembly on three assembly lines of twenty-one ships simultaneously; the transfer of the hulls on their cradles by a transfer table to a unique hydraulic launching bridge; and the launching with a hydraulic elevator. The whole arrangement preserved as nearly as possible a straight-line course for the materials of construction. Under this plan, and with a force of eight thousand men, Mr. Ford built a ship a day, fully equipped with power plant and armament, and ready for service. The system was so efficient that it took only ten days to complete a single ship. It is doubtful if this undertaking in mass production of large equipment has been duplicated in the last twenty-two years. It gives evidence of what American industry is able to do when given the opportunity.

EDITORIAL COMMENT

Leaders in business are faced at the moment by a heavy obligation, as well as by a great opportunity. Industry and business must take a definite part in the work of guiding public policies. It is not enough to point out the errors in much of the legislation passed in recent years; it is not enough to criticize and oppose. The attitude of business and industry must be constructive. Men who have the opportunity to do so, because of the position they occupy in the industrial field, must help to inform and educate the great mass of the people, whether they be industrial workers or the general public.

Industry's Part in Guiding Public Policies

As Mr. Prentis, president of the Armstrong Cork Co. and president of the National Association of Manufacturers, pointed out in a radio address this spring, every man engaged in industry can aid in the work of giving the general public a better conception of the important part played by industry in the well-being of our country. He can help by correcting erroneous conceptions and by spreading information that will aid in creating a true picture of the importance of the work of industry. He can help by refuting misinformation with facts.

It may sound paradoxical to an engineer to say that new ideas can be accepted too readily; and yet there are instances when this is true. All virtues, if carried to excess, become vices; thrift becomes penuriousness; courage becomes foolhardiness. In mechanical work, accuracy, while highly commendable when required, may become the cause of much wasteful effort; and too eager acceptance of new ideas may be an indication, not of progressiveness, but of poor judgment. A new process, a new tool, may be highly useful; but when an attempt is made to apply it in too broad and universal a manner, the entire process or device may be discredited; and it will then be difficult to convince those who have witnessed the results of misapplication that it has any value, even for the purposes for which it is suitable.

Subject New Ideas to the Acid Test of Clear Thinking

There is a certain type of mind that grasps at a new idea as if it were a panacea for every possible difficulty. Men with such minds frequently do more to discredit than to assist the application of a new development. Many failures in business, many apparently valid objections to new ideas and processes, many discouraging moments in the life of pioneers, have been due not so much to the public's lack of appreciation, as to the over-enthusiasm of the promotor. Common sense and judgment are necessary in evaluating any new proposal.

Insistence on subjecting a new idea to the acid test of clear thinking is no indication that the mind is closed to the acceptance of progressive developments. As a matter of fact, it is just as dangerous to accept new ideas too readily as it is to have a mind that is closed to all new conceptions.

There will come a day when the last shot is fired; when a tired and worn bugler will sound a frail note of hope; when taps will say farewell to the dead, and men in Europe will hear a whisper—peace—peace. When that time comes men will say—"See, we have built every possible machine for destruction. We have learned to shatter time and space, and rain death. We have learned to march and conquer and lay waste overnight the treasures for which centuries of men have worked. All machines have we built save one—the machinery of enduring peace. The machinery of a way of life which spells freedom."

And by that light, Europe will build anew out of its ruins and ashes of despair. Our part in America today and tomorrow is to keep our light of freedom burning. It was kept alive in the winter snows and pain of Valley Forge. It was kept alive in the heartbreak year of 1864. It must be kept alive now.
From The Shaft, published by Edgar T. Wood's Sons Co.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Reversing Transfer Mechanism

By L. KASPER

The mechanism here illustrated is used on a wire fabricating machine for transferring a flat wire *W* from its original working position, shown in Fig. 1, to the position indicated by dotted lines at W_1, Fig. 2. It will be noted that this transfer movement turns the flat wire upside down. Two synchronized assemblies or mechanisms like the one shown are used to support the wire at both ends.

Referring to Fig. 1, the reciprocating movement is transmitted to slide *A* by a cam-actuated connecting-rod *B*. Gear *C* and lever *D*, which are keyed together, are mounted on stud *J*, fixed on slide *A*. Rotation of lever *D* is stopped when the ends of a semicircular slot *S* in gear *C* come in contact with a pin *K* in slide *A*. Gear *C* meshes with a rack on the upper edge of plate *E*, which carries the two flanged bushings *I* and spring *G*. The bushings *I* are free to slide in plate *E* on the shaft *F*, which is supported by the two blocks *H*, attached to a stationary part of the machine. The length of the bushings *I* is such that when in position in plate *E*, the length of the assembly is exactly the same as the distance between blocks *H*. Thus any movement of plate *E* in either direction is resisted by spring *G*, which serves to equalize the position of the plate between blocks *H*.

In Fig. 1, slide *A* and lever *D* are shown approaching the end of their travel to the left. It will be noted that the pin *K* is in contact with the end of slot *S* in gear *C*. The movement of slide *A*, up to this point, gives to gear *C* and lever *D*, to which it is attached, a rotative motion. Meanwhile plate *E* is held stationary by spring *G*. In the position shown in Fig. 1, the upper end of lever *D* is advancing to receive the work *W*, which slides under the spring *L*. When the end of slot *S* comes in contact with pin *K*, the rotative movement of gear *C* is stopped and the continued movement of slide *A* is transmitted through gear *C* to slide *E*, which is then moved against the resistance offered by spring *G*. In this manner, a straight line movement of lever *D* is produced near the end of its travel to the left.

In Fig. 2, slide *A* is shown in the position it occupies at the end of its movement to the left, the work *W* being gripped under spring *L* on the end of lever *D*. On the return stroke of slide *A*, lever *D* returns in a straight-line movement to the position shown by the dotted line at *M*, which coincides with the position shown in Fig. 1. As plate *E* is returned to its central position, continued movement of slide *A* to the right causes gear *C* to be rotated on stud *J* until pin *K* is in contact with the opposite end of slot *S* in gear *C*, at which time lever *D* is in

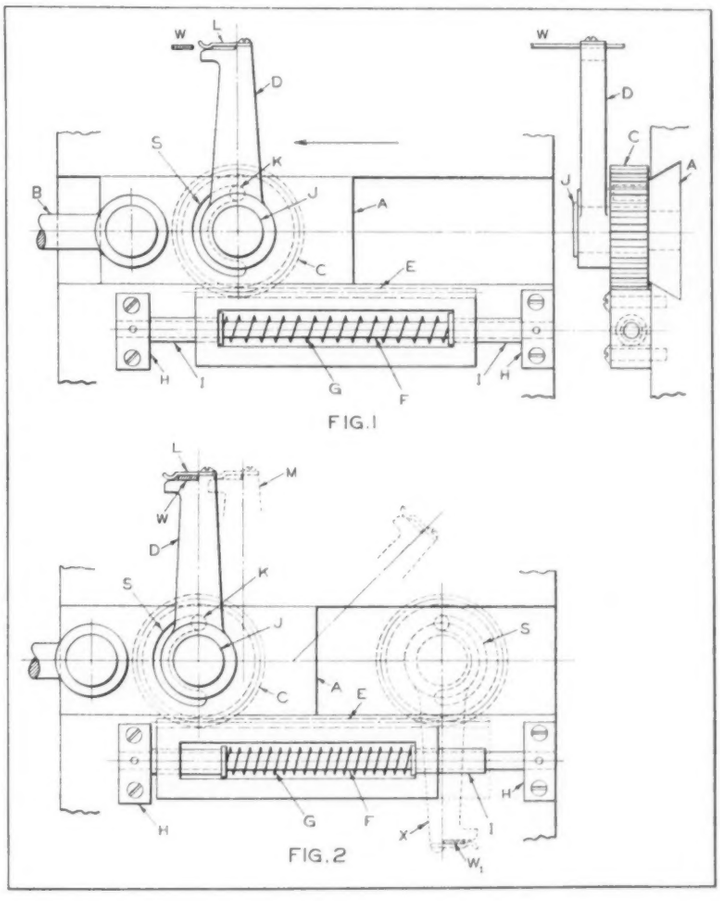


FIG. 1

FIG. 2

Fig. 1. Mechanism Designed to Pick up Wire W and Transfer it to the Position Indicated by Dotted Lines at W_1 in the Lower View. Fig. 2. Diagram Illustrating Movement of Transfer Lever D

the position *X* indicated by dotted lines. A straight-line movement to the right is then transmitted to lever *D* until work *W* arrives at the point at which it is to be discharged. As the slot in gear *C* permits a rotative movement of 180 degrees, the work is given a full reversing or turning movement while being transferred from one position to the other.

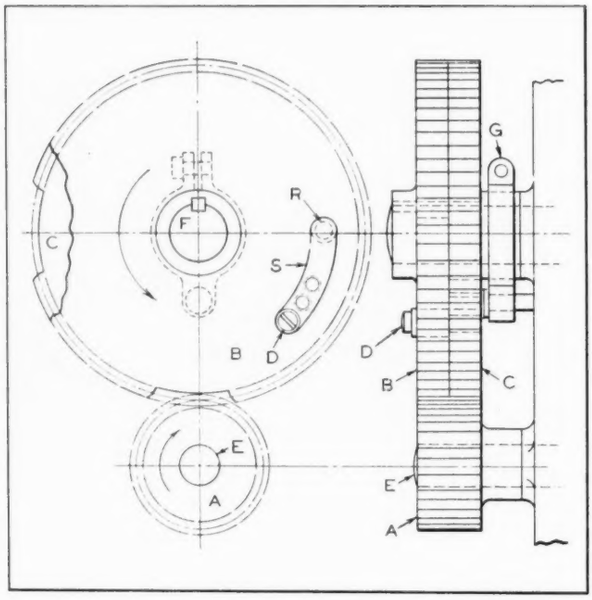
Adjustable Intermittent Rotary Movement

A conveyor belt used on an assembling table required a dwell or rest period at specified intervals in order to permit loading. As the table was used for a variety of assembling operations, some means for adjusting the rest period was necessary. The accompanying diagram shows the adjustable intermittent gear mechanism designed to meet these requirements.

The shaft *E* carries the driving pinion *A*, which rotates in the direction indicated by the arrow. Shaft *F*, which carries the conveyor belt, also supports the mutilated gear *B* which is keyed to it, as well as the mutilated gear *C*, which is free to rotate on shaft *F*. Both gears *B* and *C* mesh with the pinion *A*. Gear *B* has a slot *S* in it, while gear *C* carries the stop *D*, which is located in one of the tapped holes provided for it and is free to move in slot *S*.

The tapped holes for stop *D* in gear *C* are so located that when stop *D* is in any one of them, and in contact with either end of slot *S*, the teeth in gears *B* and *C* will be in exact alignment. The brake *G*, acting on the hub of gear *C*, provides sufficient resistance to prevent accidental rotation of gear *C* due to friction.

In the diagram, pinion *A* is shown in mesh with gear *C*, which it is driving in the direction indicated by the arrow. Gear *B*, however, remains stationary, as the mutilated portion is in line with pinion *A*. This arrangement provides the rest period required for the conveyor belt. Rotation of gear *C* causes stop *D* to be moved to the opposite end of slot *S*, as shown by the dotted circles at *R*. When it reaches this position, the movement of gear *C* is again transmitted to gear *B* through stop *D*, both gears then being rotated in unison and transmitting motion to the belt.



Mechanism for Obtaining Adjustable Intermittent Rotary Motion

As the mutilated portion of gear *C* reaches pinion *A*, its movement ceases while gear *B* continues to rotate. Gear *C* remains stationary until stop *D* is again located in its original position in the slot in gear *B*, when both gears again rotate in unison. During this period the conveyor belt has continued its movement, the only purpose of the gap in gear *C* being to permit the two gears to change their relative positions, so that the stop *D* will again be in position for the next rest period. The relative positions of the mutilated sections of gears *B* and *C* are immaterial, provided that no part of the two gaps overlap.

When a shorter rest period is required, an additional stop *D* is placed in one of the other tapped holes, thus reducing the effective length of the slot in gear *B*. As the amount of movement of the conveyor belt between stations is controlled by the number of teeth in gear *B*, any change in the period of rest does not affect the length of travel between stations.

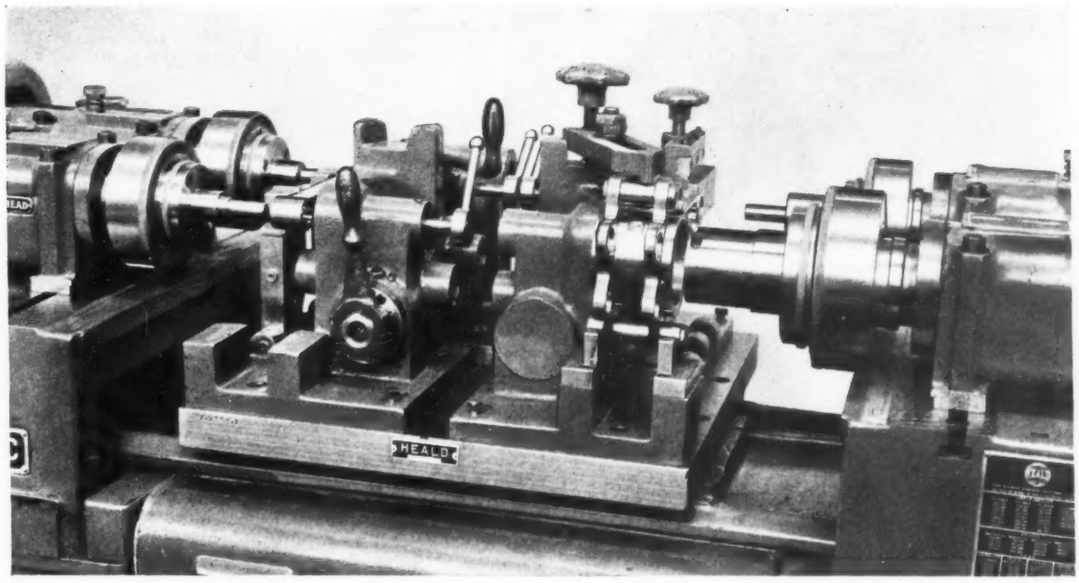
K. L.

* * *

Alloys that Improve the Properties of Steel

A new class of ferro alloys has been introduced by the Vanadium Corporation of America under the group trade name "Grainal." These alloys are used in steel-making to produce desirable properties in steel. One of these alloys contains 25 per cent vanadium, 15 per cent titanium, and 10 per cent aluminum; another contains 13 per cent vanadium, 20 per cent titanium, and 12 per cent aluminum; while a third contains 20 per cent titanium, 20 per cent aluminum, and 6 per cent zirconium.

The advantages claimed for these alloys when introduced in the steel while making it are: (1) They make it possible to produce steel of uniform properties from heat to heat. (2) They make it possible to convert some water-hardening steels into oil-hardening steels and to increase the section of alloy steels that may be hardened throughout. (3) They permit the production of steel of unusual physical properties at an economical cost. (4) It is possible to add the alloy to the steel without complicating, in any way, the usual steel-making processes. (5) It is possible to add the alloy to the ingot as well as in the ladle, so that a single heat of steel may be made to meet several physical-property specifications, thereby increasing the flexibility of steel-making furnaces of large size.



Master Rods and Articulating Rods for Russian Aircraft Engines are Precision-bored at Both Ends on the Machine Here Shown

Precision-Boring Master Rods and Articulating Rods

Master rods and articulating rods are precision-bored at both ends in one operation on the Heald Bore-Matic shown above, which is in operation in a Russian airplane plant. The bronze-bushed articulating rods are bored at the left-hand side of the machine and the babbitt-lined crank hole and bronze-bushed wrist-pin hole of the master rods, at the right-hand side. The four boring heads are equipped with retracting units which automatically back off the tools at the end of the boring stroke, so as to eliminate drag on the finished surfaces when the tools are withdrawn through them.

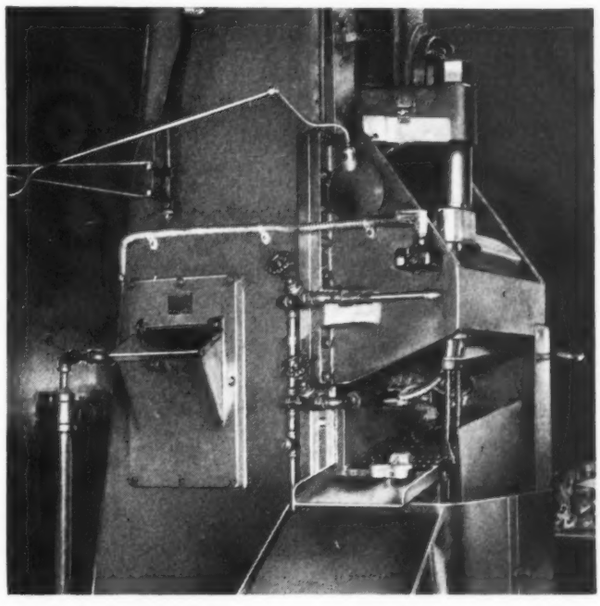
The articulating rods are located from both bores by means of retracting bore-centering plugs and are held from the web by two hand-operated clamps. The master rods are located by a retracting centering plug in the wrist-pin hole and by a V-block which is located from a pin that is slipped through two articulating wrist-pin holes.

After loading an articulating rod in the fixture, the operator engages the table reverse lever, causing the table to travel toward the left for boring both ends of the articulating rod. Upon the completion of this boring step, the table stops and the operator then loads a master rod on the right-hand side of the fixture. The table is operated to the right for boring the master rod.

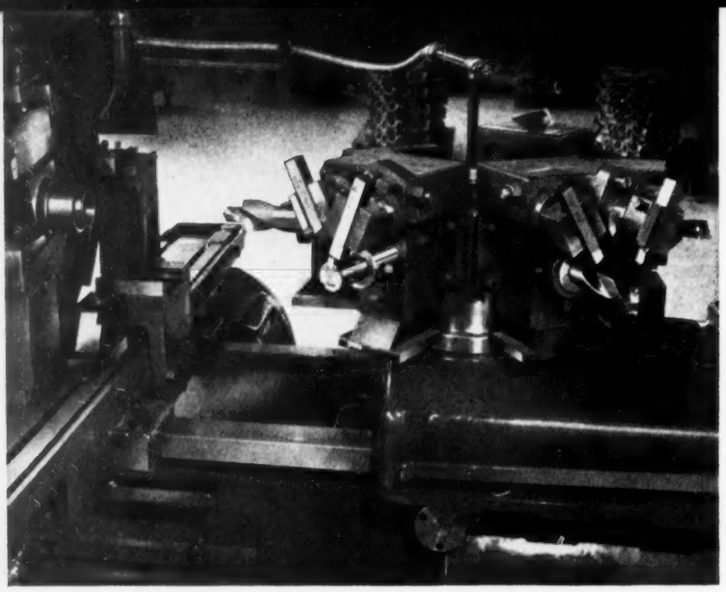
* * *

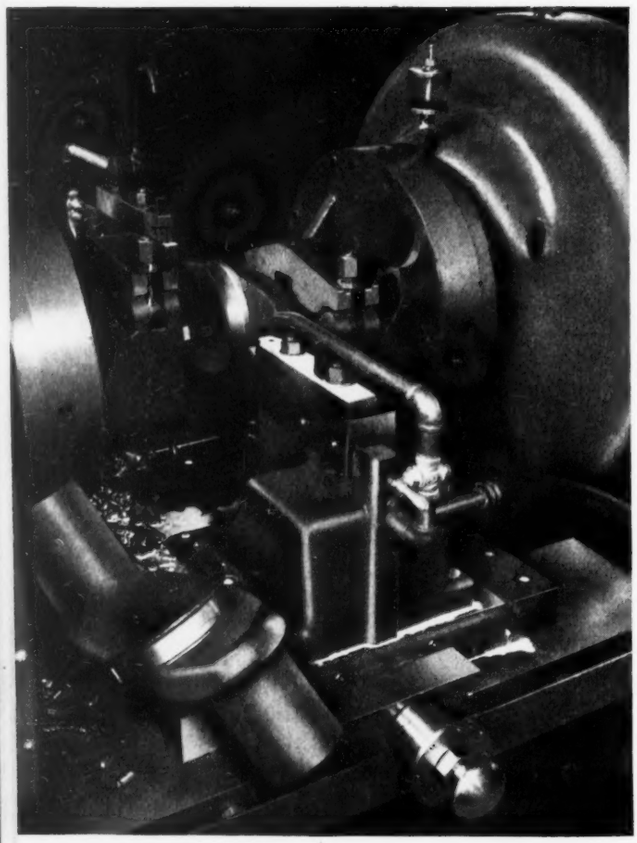
Broaching Parts for Combat Cars

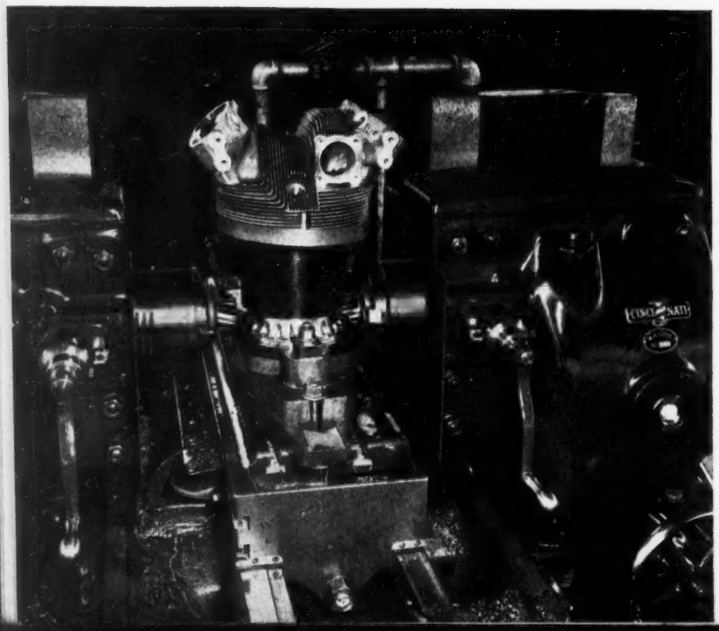
Track connections for combat cars and tanks are simultaneously broached in both holes in an American vertical, hydraulically actuated broaching machine at the Rock Island Arsenal. The parts are chromium-nickel-steel forgings 1 1/4 inches thick at the bosses, and both holes are broached to a diameter of 1 inch. The operation is performed as the broaches are pulled upward through the piece. At the end of the stroke, the piece falls clear of the broaches, which are automatically lowered and disconnected. When a new workpiece has been slipped over the broaches, they are again automatically connected to the puller for the next stroke; 200 pieces are broached hourly.



Broaching Track Connections for Combat Cars and Tanks







"Wright Aero" Plans for

Outstanding Production Methods Employed in Building Airplane Engines to Meet the Present-Day Demand—Second of Two Articles

HOW production men in the aircraft industry devised manufacturing methods to meet the high rates of output demanded today was outlined in the article which appeared in July MACHINERY, pages 134 to 139. The present article will describe additional outstanding operations in the airplane engine-building plant of the Wright Aeronautical Corporation, Paterson, N. J.

Two Potter & Johnston automatics are employed for taking rough and finish turning, boring, and facing cuts on rear crankshaft sections (Fig. 13). Both of these machines are used on the same end of the forging. They are provided with a wide T-slot guide on the cross-slide base, which is engaged by mating tongues at the bottom of each turret tool-head, so as to insure accurate alignment and strong support of the turret tools during cutting. A cam-block is attached to the top of the guide on the cross-slide base for actuating turret-slide tools sidewise as required.

In the roughing operation, which is not illustrated, three drills on the turret are employed for drilling a hole from solid stock while tools on the cross-slide turn the hub and face the adjacent crank and counterweight cheeks. Then, in the operation shown in Fig. 13, a tool on the first station of the turret, which is seen in line with the work, takes a small and a large diameter boring cut at the same time. The tools on the next turret station rough-turn the front end of the hub to form a shoulder and take a second boring cut on the large diameter hole.

Tools on the third turret finish-bore the small diameter hole and finish-turn to the hub shoulder. The fourth face of the turret is equipped with a

Fig. 13. (Top) One of Two Automatics Employed for Rough and Finish Boring, Turning, and Facing Rear Crankshaft Sections

Fig. 14. (Center) Crankshaft Lathe for Rough- and Finish-turning the Center Bearing on the Center Section of Crankshafts

Fig. 15. (Bottom) Hydromatic Milling Machine of Duplex Design which Finishes Flats on Opposite Sides of Cylinder-barrel Flanges

Unprecedented Output

By P. W. BROWN
General Superintendent
Wright Aeronautical Corporation
Paterson, N. J.

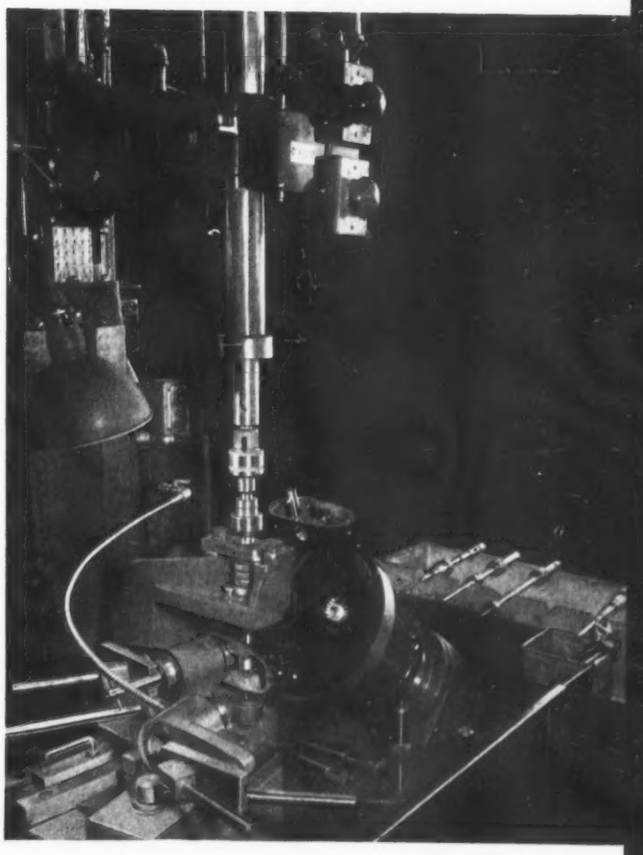
tool mounted on a slide, so that it can be moved sidewise by the cam-block on the cross-slide base after it has been fed to depth, for forming an under-cut in the bore of the work.

The fifth turret face is equipped with tools for another boring operation on the large diameter hole and for finish-turning the large hub diameter. Finally, a slide tool on the sixth turret face is employed for taking a chamfering cut on the inside of the hole. While these various cuts are in progress, facing cuts are taken by cross-slide tools on the hub end and shoulders.

The center bearing of the center section of a crankshaft is being rough- and finish-turned from the rough forging in the operation illustrated in Fig. 14, which is performed in a Wickes crankshaft lathe. The crankshaft is being driven from both ends, being held at each end in a pot type chuck equipped with a hinged clamp that facilitates reloading. Three tools mounted vertically on the front of the cross-slide take the roughing cuts, the bearing being then accurately finished as to width and depth by three finishing tools at the rear of the cross-slide. One of these is mounted horizontally, and the other two vertically.

Four flats are milled on the flange of cylinder barrels in two operations performed on Cincinnati Hydromatic milling machines set up as shown in Fig. 15. Regular end milling cutters are used. There is a fast traverse to carry the work from the loading position to the cutters and then a feed at a reduced rate as the work moves past the cutters, the table being actuated hydraulically during its entire cycle.

Fig. 16 shows one of the many examples of high-



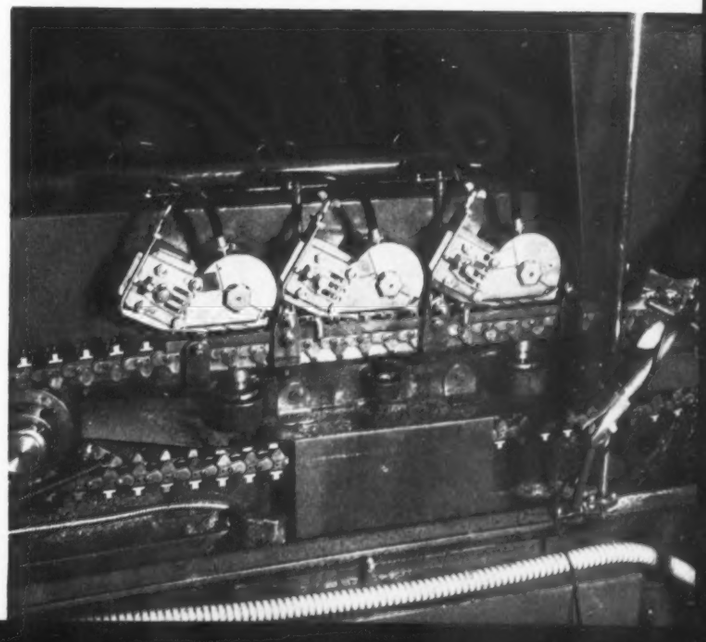


Fig. 16. (Top) Internal Teeth of Cam Rings are Cut in Roughing and Finishing Operations Performed on a Fellows Gear Shaper

Fig. 17. (Center) Ingenious Tooling Equipment for a Series of Operations on the Rocker-shaft Holes in Cylinder Heads

Fig. 18. (Bottom) Nut-castellating Machine Arranged for Cutting All Six Castellated Slots in One Passage beneath the Cutters

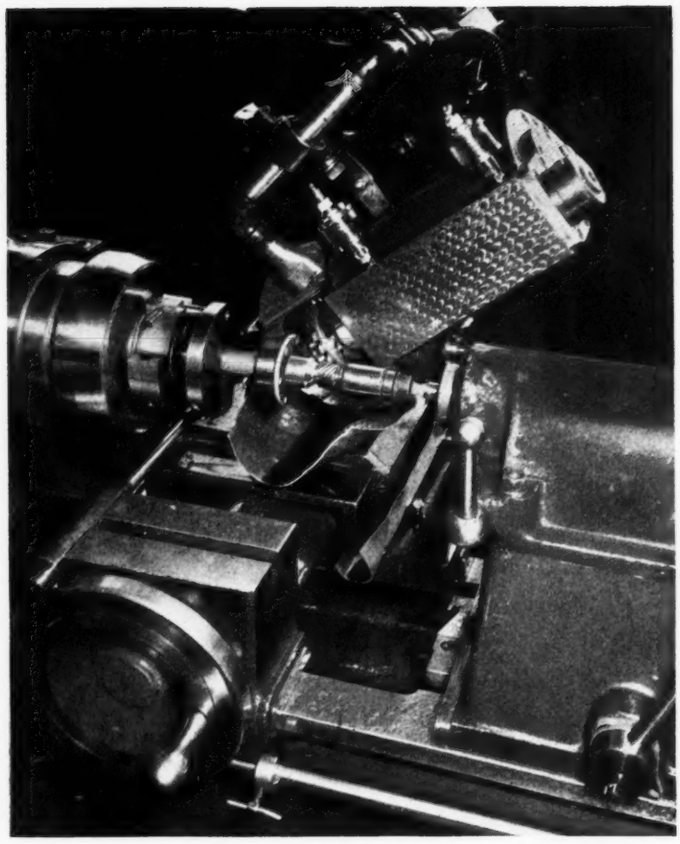


Fig. 19. Thread-milling Machine Employed for Cutting a Small Worm-gear on a Nitralloy Steel Shaft

grade gear cutting in the extensive gear-cutting department, where, incidentally, all external gear teeth are also ground. The operation shown consists of finish-cutting the internal teeth around a cam ring on a Fellows gear shaper.

An ingenious method devised for line-reaming the rocker-shaft holes in cylinder heads, spot-facing the bushings, and taking several other cuts, is shown in Fig. 17. This operation, which is performed on an Allen single-spindle drilling machine, consists of using a double-end cutter for spot-facing and back-facing the two inner ends of the bronze bushings, of forming a spherical surface, of chamfering and counterboring the two outside bosses of the aluminum head, and of line-reaming the two bores.

The facing cutter is assembled on the tool-spindle after the latter has been lowered through the upper of the two rocker-shaft holes and applied by first feeding the cutter against the bottom bushing and then raising it against the upper bushing. The other tools are interchanged while the tool-spindle is above the work. Stop-collars limit the up-and-down feed movements of the facing tool and the form tool employed for finishing the spherical seat. A tolerance of 0.002 inch is specified on the distance between the two faced bushing ends. The fixture can be indexed for machining each pair of rocker-shaft holes.

Nuts are castellated at a high rate of speed in the Pellow machine shown in Fig. 18, which is arranged with two conveyor chains that carry the nut blanks past three slotting cutters mounted on both sides of the machine. The conveyor chains are fitted with small chucks into which the nuts are slipped by an operator standing at the right-hand end of the machine, the drilled hole in the nuts being seated on studs in the center of the chucks.

As the conveyor chain carries each chuck beneath the first cutter at the right, two of the castellated slots are milled. Then a finger mounted on a bar in front of the conveyor chain engages a slot in the chuck and indexes it through 60 degrees, so that it is in position for the milling of two more slots by the second cutter. Again, the chuck and nut are indexed 60 degrees before they reach the third saw, which completes the slot-cutting.

The castellated nuts are automatically discharged from the chucks after they pass around the sprocket

Fig. 20. Loading End of Machine for Cleaning and Tin-plating Steel Cylinder Barrels on a High-production Basis

seen at the left-hand end of the machine, by a spring-actuated "knocker" which strikes a blow on each chuck on the side opposite to the nut. The saws and nuts are flood-lubricated.

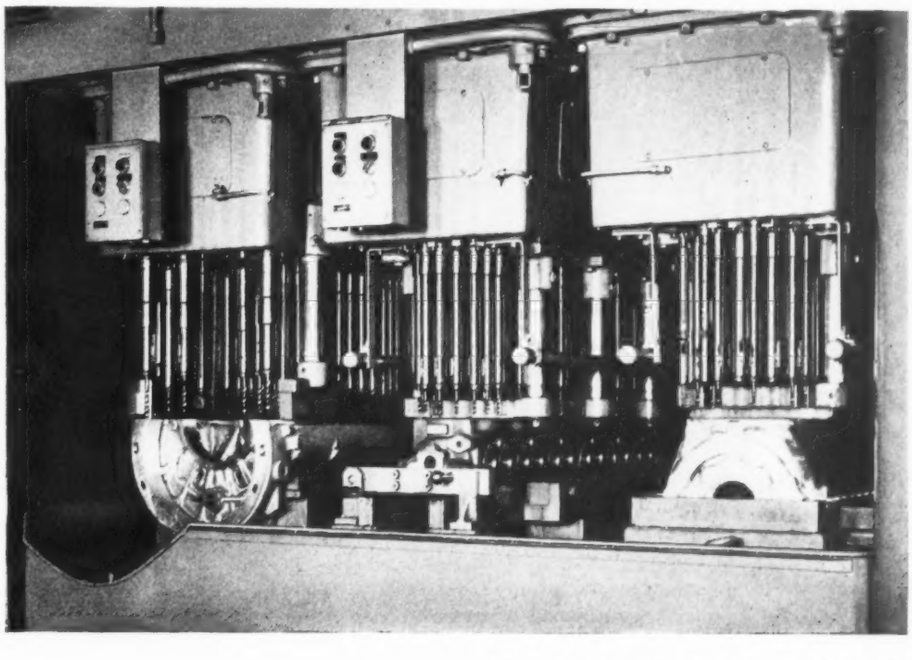
In Fig. 19 is shown a Lees-Bradner thread-milling machine cutting a small worm-gear on a Nitralloy steel shaft. The threads of this worm are later lapped.

With the development of high-production methods for the machining of engine parts, it became imperative also to speed up cleaning, plating, and heat-treating methods. In Fig. 20 is shown a machine which thoroughly degreases, cleans, pickles, and tin-plates steel cylinder barrels as they are automatically transferred into a series of tanks arranged in a line. This plating operation is performed prior to nitriding. These cylinder barrels are suspended from hooks attached to cross-bars of a conveyor, as seen in the illustration. When the barrels reach the far end of the machine and have been tin-plated, they are returned overhead by the conveyor to the starting point.

* * *

High-Production Tapping in an Aircraft Engine Plant

One of the more unusual operations in the new air-conditioned, windowless factory of the Allison Engineering Co., Division of the General Motors Corporation, at Speedway, Ind., consists of tapping 156 holes simultaneously in cylinder heads and crankcases. This operation is performed by the Natco machine shown in the illustration, which is equipped with three multiple-spindle heads. These heads are operated vertically to and from the work by hydraulic power. Fifty-four taps are provided on the left-hand head, which taps the crankcases; thirty-four on the central head, which taps the coolant jacket side of the cylinder heads; and sixty-eight on the right-hand head, which taps the camshaft side of the cylinder heads. The cylinder heads and crankcases are held securely in the fixtures by clamps that are also actuated by hydraulic means. The taps range from 5/16 to 5/8 inch in diameter.



Tapping 156 Holes in Crankcases and Cylinder Heads in a Hydraulically Operated Machine

Welded Repair Job that Saved Over One Thousand Dollars

The bed of a 50-ton stamping press installed at the Samuel Stamping & Enameling Co., Chattanooga, Tenn., recently fractured. A new cast-iron bed would have cost $1200. Considerable delay in operations would also have resulted by the making and installing of a new bed. The broken bed, however, was repaired in two days by the Tallent Machine Shop, of Chattanooga, at a cost of only $125. The break occurred through a section 30 inches long, 12 inches deep, and 4 inches thick. After being V-cut and studded, the break was welded with General Electric shielded-arc electrodes, and the joint was further reinforced by an arc-welded steel plate. No preheating or machining was necessary, but each bead was peened after it was laid.

* * *

Industrial Machinery Exports Remain at High Level

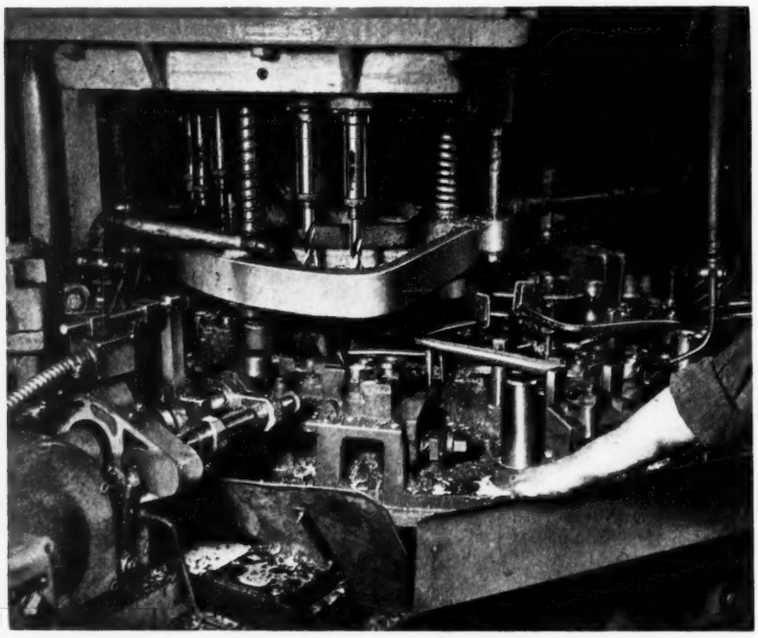
United States exports of industrial machinery for the month of June, the last month for which complete statistics are available, amounted to $35,695,000, according to the Machinery Division of the Department of Commerce, Washington, D. C. The shipments were nearly 60 per cent above those of the corresponding period in 1939. The exports of power-driven metal-working machinery amounted to $18,565,000 in June, and of metal-working machinery other than power driven, $597,000. In the shipments, lathes represented $3,870,000; milling machines, $1,807,000; grinding machines, $2,344,000; and drilling machines, $1,177,000, the latter item showing a substantial increase as compared with May, this year.

Machine Built by Using Tool-Heads from Other Equipment

A machine for drilling, reaming, and tapping clutch and brake pedals was recently built up from tool-heads salvaged from machines no longer required, by the tool engineering department of the Pontiac Motor Division of the General Motors Corporation, Pontiac, Mich. A close-up view of the tooling provided on this machine is here shown. One clutch pedal and one brake pedal are loaded in each of the six stations of the indexing fixture and locked in place by air-operated clamps.

In the first working station at the left, a shaft hole is drilled half way through each pedal by drills on the upper tool-head, and at the same time the horizontal head seen extending toward the left drills an adjusting screw hole in the clutch pedal. In the next indexed position, the shaft hole is drilled completely through each pedal and a smaller hole is drilled in both pedals, all by tools carried on the upper head. In the third indexed position, a horizontal head taps the adjusting screw hole in the clutch pedal, and at the same time the shaft hole in both pedals is reamed by tools mounted on the upper head. Grease holes are drilled in both pedals by a horizontal head in the fourth position, and these holes are tapped by another horizontal head in the fifth position.

The principal advantage of this machine is that by combining a considerable number of operations, complete machining is accomplished in one loading, and, therefore, frequent handling of the two parts has been eliminated, thereby obtaining a considerable saving in the floor-to-floor time.



Special Machine and Tooling Designed from Tool-heads of Machines no Longer Required, for Drilling, Reaming and Tapping Operations on Clutch and Brake Pedals

American Welding Society to Meet in Cleveland

The annual meeting of the American Welding Society will be held in conjunction with the National Metal Exposition in Cleveland, Ohio, October 21 to 25. Headquarters for all technical sessions and committee meetings will be at Hotel Cleveland. Fifty-nine technical papers, covering practically every phase of welding, cutting, and treating processes, will be presented at the fifteen technical sessions planned. There will be separate sessions on machine manufacture, resistance welding, and structural welding. Four sessions will be devoted to fundamental and industrial research. The metallurgical aspects of welding will be covered in two sessions. Applications to the steel, shipbuilding, and railroad fields will also be dealt with. The Samuel Wylie Miller Memorial Medal and the Lincoln Gold Medal will be presented at the opening session of the meeting, Monday, October 21.

* * *

The Way to Get Trained Men is to Train Them

In a booklet published by the Trundle Engineering Co., of Cleveland, Ohio, attention is called to the fact that, in carrying out the industrial preparedness program, while we have a shortage of *trained* men, we do not have a shortage of *men*. The answer to the problem is training. The real training, however, must be done in the shops. It cannot be done in classrooms, nor can it be done by the government. It must be done by industry and in productive work. "The genius of American industry," says the booklet, "is not harnessed to an hourglass. Time and again we have demonstrated that we can do big things more rapidly than any other country in the world. Today we can do it again—but not for the fun of it. This time it is a matter of necessity."

* * *

An impregnating or saturating compound for making fabrics electrically conductive has been developed by the Acheson Colloids Corporation, Port Huron, Mich. The coating hardens on exposure to light after application and may be applied at normal temperatures (or at slightly elevated temperatures to promote rapid drying). It contains colloidal graphite, a hardenable organic colloid, and a hardening agent.

Wheel-Dressing Fixture for Step-Grinding

By H. J. CHAMBERLAND, Springfield, Mass.

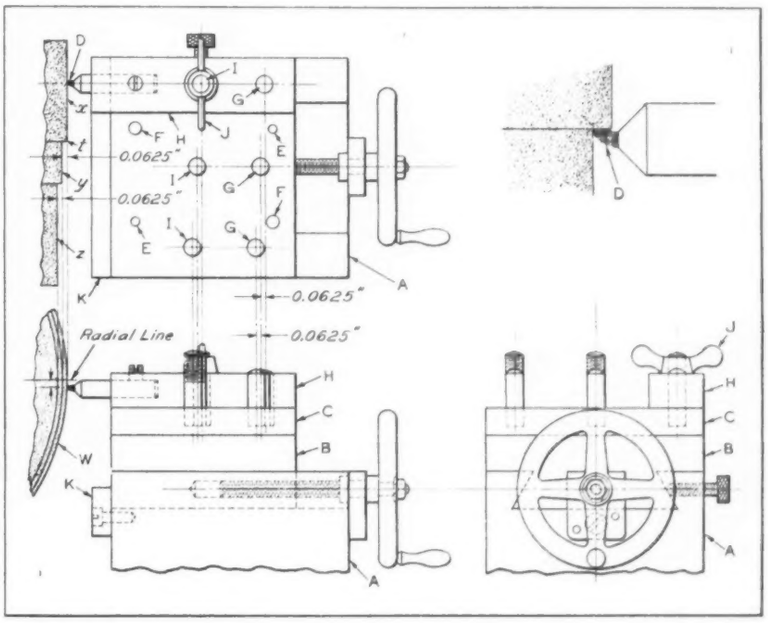
The practice of step-grinding cylindrical work to two or more diameters simultaneously by the in-feed or plunge-cut method requires accurate dressing of the grinding wheel. The wheel-dressing operation is an especially important factor in step-grinding such work as armature shafts for small motors, where the production rate is as high as 140 shafts per hour and the grinding tolerance is held to plus or minus 0.0002 inch.

In some plants, special means have been devised for dressing the wheel for step-grinding; but the conventional procedure is to employ the graduations on the cross-feed slide in dressing the wheel to the required shape. The success of the latter method depends largely on the skill of the operator.

The fixture shown in the accompanying illustration has been designed to facilitate accurate and economical dressing of wheels used for step-grinding three different diameters and two steps. It is made with a base *A* to suit the grinding machine to be used. A dovetail slide *B* with an adjusting screw operated by a handwheel is fitted with an interchangeable jig plate *C*, which is the important feature of the fixture. The jig plate is located on slide *B* by dowels *E*, and held in place by screws *F*.

The holder *H* in which the truing diamond *D* is mounted is located on plate *C* by pins *G* and *I*. Pins *I* are threaded to receive wing-nut *J* which secures holder *H* in place. It will be noted that there are three sets of pins *G* and *I*, each set being located 0.0625 inch nearer the grinding wheel than the preceding one for truing the three surfaces.

With the fixture set up as shown, and with the diamond shaped and set for step-truing as indicated in the enlarged view in the upper right-hand corner of the illustration, the entire face of the wheel *W* is dressed to the required diameter at *x* by traversing the grinder table and adjusting the cross-slide, which is locked in this final dressing position. This cross-slide setting is not disturbed during the succeeding operations. Next, slide *B* is moved back about 1/8 inch and bar *H* relocated on the central set of pins *I* and *G* for truing wheel *W*



Fixture for Dressing Wheels for Plunge-cut Step-grinding which has Interchangeable Plates C for Wheels Used on Different Jobs

to the required diameter at y, which gives a stepped surface 0.0625 inch below the first surface.

A traverse stop for the table is then set to determine the position of the shoulder or step t. Slide B is then fed in, and the table traversed back and forth up to the table stop until the slide reaches stop K on the fixture. The dressing movement should be toward the shoulder. This brings the wheel to the correct diameter at y.

Slide B is now withdrawn about 1/8 inch and block H transferred to its third position for dressing the third surface to the required diameter at z. For dressing wheels used for steps of different depths, it is only necessary to change plate C and proceed with the dressing operation as described.

Adjustable Indexing Fixture for Perforating Metal Cylinder

By JOSEPH WAITKUS, Wellsville, N. Y.

Recently a designer was called upon to develop a tool for punching slots in a metal cylinder like the one shown at A in the illustration. The cylinder is fabricated from a thin stainless-steel sheet. The rows of slots are uniformly spaced around the periphery of the cylinder, alternate rows being provided with two slots to produce a staggered arrangement. It was necessary that the fixture be designed to permit altering the size, number, and spacing of the slots.

Two methods of manufacturing the cylinder were considered. The first required the complete perforation of a sheet which was then rolled into a cylinder and welded, the rolled edge at each end being produced as a final operation. This method did not appear to be very satisfactory, because it was difficult to handle the perforated sheet in the rolling operation without a good deal of distortion, due partly to stresses set up in the sheet as a result of the rolling and welding. It was also difficult to line up a perforation if the spacing was such as to place it at or near the seam of the cylinder.

Better results were obtained by first fabricating the cylinder completely and then perforating it as desired. Adoption of this method resulted in the development of the perforating fixture of interesting design shown in the illustration. The entire assembly is intended to be attached to the bedplate of an ordinary punch press, the reciprocating motion of the crank-arm providing the necessary force for actuating the punch in the fixture.

The assembly consists of a trunnion Z to which the die-plates B and C are fastened with screws D. The holes in the die-plates are large enough to permit a little adjustment in the position of the plates in relation to their respective punches. Die-plates B and C differ from each other only in that B is for three slots, whereas C is intended for two slots. The trunnion Z is fitted into a bearing in the main support bracket E, and is retained in place by crank F which, in turn, is pinned to the shaft of trunnion Z.

In order to eliminate the cantilever extension or overhang of trunnion Z, index-plate H is provided with a machined center projection which fits neatly into the open end of the trunnion. In this manner, the trunnion is well supported to carry the load imposed upon it by the punch. The shaft of index-plate H extends through a bearing in arm J and is retained in place by indexing knob K which is pinned to it. Indexing ball M rests in a series of indentations on index-plate H and determines the spacing of the slots on the cylinder.

The spring at the rear of the ball tends to keep ball M resting in the indentation. A cap-screw O retains the spring in place. The arm J is hinged to the main support bracket E by stud P. A nut with a handle Q is provided for locking arm J in position for supporting trunnion Z.

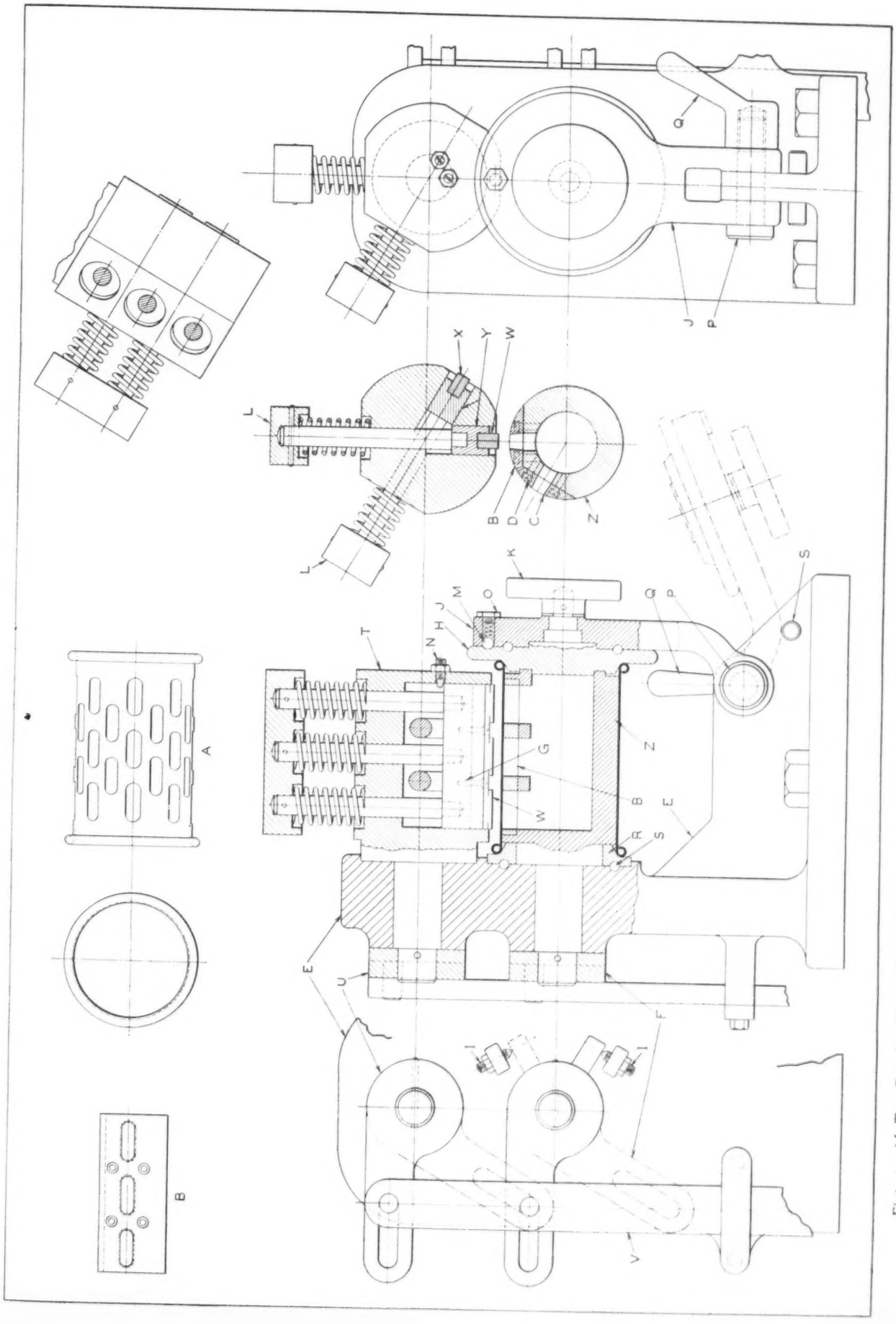
The cylinder to be punched is gripped between tapered extensions on index-plate H and ring R. Both the index-plate and the ring are provided with ball bearings S to permit easier rotation or indexing of the cylinder after each row of slots is punched.

The punch member is of unusual interest. It consists of a trunnion T, fitted into a bearing in the main support bracket E and retained in place by lever U pinned to the shaft of trunnion T. Two sets of punches are provided in trunnion T which correspond to the two die-plates B and C in trunnion Z. The entire punch assembly consists of punch-plates W and X for three slots and two slots, respectively. The plates are retained in their respective holders Y by screws G. Slots machined in trunnion T at a definite angle serve to guide the holders Y.

Rods fastened to holders Y extend through guide holes in trunnion T and terminate in head plates L, to which the rods are fastened by pins. It will be noted that the three-punch plate W is provided with three rods, whereas the two-punch plate X has two rods. This arrangement permits the two rods to pass through the spaces between the three rods and thereby make one punch assembly independent of the other. Coil springs, as shown, serve to keep the punch-holders resting against adjusting screws N. Tapered shanks on the adjusting screws permit adjusting the punches to a fine degree, after which the screws can be locked with their respective lock-nuts.

The two trunnions Z and T are operated by levers F and U, respectively, which are, in turn, connected to bar V by pins. Bar V is guided in a bearing that forms a part of the support bracket E. In order to control the angle of operation of the levers, two adjustable stops are provided which consist of adjusting screws I and their respective lock-nuts.

The operation of the fixture is quite interesting. The cylinder to be punched is slipped over trunnion Z to which it is fitted very neatly. Arm J is then raised from the position indicated by the



Fixture with Two Punches W and X and Dies B and C, which are Alternately Indexed into Position for Punching Two and Three Holes in Cylinder A

broken line, where it rests on pin *S*, into the operating position, with the center projection on index-plate *H* fitting into the open end of trunnion *Z*. At the same time, the cylinder is clamped between the tapered projections on index-plate *H* and ring *R*. Arm *J* is then locked in position by tightening a nut by means of handle *Q*.

The cylinder is now ready for the perforating operation. Starting with the three-slot punch *W*, the punch press is tripped and the crank-arm comes in contact with head plate *L*. The force is transmitted through the rods to punch-holder *Y*, and together they are forced down until the punch pierces the cylinder shell and deposits the waste material in the hollow space at the center of trunnion *Z*. As soon as the pressure is relieved on head plate *L*, the punch returns to rest against adjusting screw *N* under the action of the coil springs.

The next operation is to turn the cylinder and trunnion *Z* so that the work is lined up for punching the next row of slots. The indexing knob *K* permits turning index-plate *H*, together with the cylinder, until ball *M* rests in the next indentation. At the same time, bar *V* is pulled down and levers *F* and *U* set in the positions indicated by the broken lines.

Screws *I* limit the motion and place the levers in their proper relative positions. As the levers are moved, the trunnions are turned through the same angle until the punch and die are in line for the next punch press operation. The procedure of punching is repeated, producing two additional slots. The waste material collected in the hollow space of trunnion *Z* is removed after each cylinder is completed.

It is obvious that the die design described lends itself to a variety of slotting arrangements. The spacing can be altered by changing the index-plate. The size and shape of the slots can also be changed readily by substituting various punch-plates and corresponding die-plates.

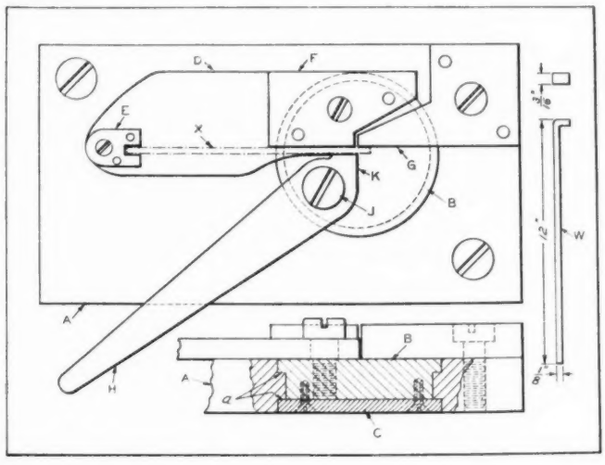
Simple Fixture for Making Right-Angle Bend

By DONALD A. BAKER, Hartford, Conn.

In making the right-angle bend at the end of the part shown at *W* in the accompanying illustration, the work is brought up to a red heat and the bending operation performed quickly. The carbon content of the material and the small cross-section of the piece made this procedure necessary in order to avoid the possibility of fracture. The simple fixture illustrated, which was designed to perform the bending operation, has proved very efficient.

Base *A* of the fixture can be made of either cast iron or steel. Rotating member *B* and the round flat plate *C* attached to it by screws are held in place between shoulders *a*. Fastened permanently to the top of member *B* is an arm *D* with locating plates *E* and *F* which are held in place by screws and dowels. At *G* is a hardened steel plate which is fastened permanently to the base. Lever *H* pivots on a shouldered screw *J* on the rotating member *B*.

The part to be bent is located at one end of the fixture by plate *E*, and at the other end between plate *F* and the jaw end of lever *H* in the position shown by the dot-and-dash lines at *X*. Lever *H* is then pulled forward, closing the jaw and forcing



Fixture for Making Right-angle Bend in Work Shown at W

the work against plate *F*, while the continued movement of the lever rotates member *B* which carries arm *D* and the work. This movement of lever *H* bends the end of the work until point *K* comes to a stop against the face of plate *G*. If a bend of more or less than a right angle is required, a change in the shape of surface *K* will give the desired result.

* * *

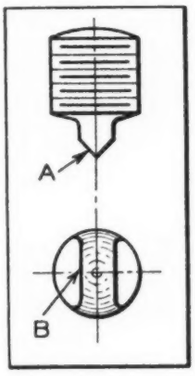
New "Low-Bake" Metal Finish

A new industrial finish with exceptionally low-temperature speed baking characteristics and known by the trade name "Polymerin-100" was recently announced by the Ault & Wiborg Corporation, New York City. This finish is said to have remarkable qualities of resistance and durability, which compare favorably with those of the previously developed high-bake Polymerin, except in special cases. It has excellent film hardness, luster, adhesion, toughness, hiding power, color retention, and resistance to common deteriorating agents.

The exact baking temperatures required by Polymerin-100 depend upon the type and size of the oven, the mass of metal involved, and other factors. It is claimed, however, that the curing temperatures are the lowest ever found feasible for a speed baking finish with equivalent properties of adhesion, flexibility, color retention, and toughness.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



Spotting Screw for Transferring Blind Holes

Spotting Screw for Transferring Blind Holes

Various methods of transferring blind-hole lay-outs have been used in different shops with more or less success. The use of a pointed set-screw or spotter is, the writer believes, superior to any other known method. However, everything from a prick-punch to a file has been used to remove spotters of the usual set-screw type. Simply filing a flat *B* on two sides of the 90-degree conical point *A* of the set-screw, as shown in the accompanying illustration, affords an effective means for the removal of the screw.

A. WILHELM

Some Simple Hints for Milling Machine and Lathe Work

In the operation of a milling machine, placing the cutter as close to the front or main bearing as possible, and using the sleeve bearing in the over-arm, also as close to the cutter as possible, will help materially to reduce chatter. Keeping the over-arm bearing very close to the cutter reduces the distance the over-arm projects and makes for rigidity. On work where a greater spread is required, or where the cutter must be brought out a considerable distance from the main machine bearing, the end braces should be used.

The use of cutters of a larger diameter than required causes chatter and poor finish. Large-diameter cutters, placed far out on long arbors, cause excessive strains in the arbors. Large cutters are, of course, also much more expensive to produce.

In boring holes in a lathe, the tool should be as large in diameter and as short as possible to do the work properly. Feeds should be as heavy and deep as possible for roughing, leaving only light cuts and feeds for the finishing operation.

When a piece projecting over 6 inches from the faceplate is held in a chuck, a steadyrest should be used for boring, or the work steadied by the tail-center in the case of turning. The tool-holder should project as little as possible from the toolpost, and the tool bit should have the minimum of overhang. Tool bits, after grinding, should be carefully stoned to a keen edge; they will cut better and last longer than bits not stoned.

All long slender work should be supported in a steadyrest, or a follower rest should be used. If steadyrests are used, great care should be taken to insure that the rest is round and concentric with the centers of the work-pieces.

New Britain, Conn. WILLIAM C. BETZ

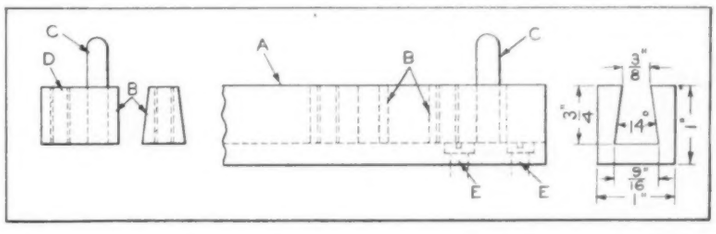
Adjustable Stop Locating Bar for Die-Shoe

A stop locating bar for a die-shoe that is very useful in making quick set-ups in a punch press is shown in the accompanying illustration. It eliminates the necessity of providing several stop-bars of the usual type for handling different jobs.

Bar *A* can be made of any desired length. The slide *B* holds the locating pin *C*. As many slides as desired can be provided for the bar. Slide *B* can be clamped in place by means of a 1/4-inch Allen set-screw inserted in the tapped hole *D*. Tightening down the screw in hole *D* serves to draw the tapered slide against the taper in the bar and thus lock it securely in place.

The stop-pin *C* can be inserted in block *B* as shown in the illustration. After the punching operations have been completed with the stop-pin in one position, the pin can be removed and inserted in the hole in the next block *B*, which has previously been clamped in the required position. Spring pins can, of course, be used in the blocks in place of the stop-pin *C*. The top of the locating slide is made flush with or a little below the top of the bar, in order to allow the stock to move freely along the upper surface. Screws *E* are used to fasten bar *A*.

Middleport, N. Y. JOSEPH SCHLINGER



Stop Locating Bar for Die-shoe which can be Made Any Desired Length and Furnished with Any Number of Stop-slides B

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Gears for Shock Resistance

A. D. C.—What kind of steel would be suitable for gears in a metal rolling and shaping machine that are subjected to shock by constant reversing and sudden stopping of the machine? Also, please recommend a suitable heat-treatment for the steel used.

Answered by Editor, "Nickel Steel Topics"
International Nickel Co., Inc., New York City

In view of the severe impact in this service, a low-carbon 3.5 per cent nickel steel, such as S A E 2315, casehardened, is recommended. This steel will offer maximum toughness, combined with sufficient surface hardness. The gears should be carburized at from 1600 to 1650 degrees F.; permitted to cool in the box; reheated to 1525 degrees F. and oil-quenched; reheated to 1375 degrees F. and oil-quenched; and then drawn to 300 degrees F. to relieve the quenching strains.

When Can an Employe be Prevented from Taking Employment with a Competitor?

C. A. G.—Can an employe of a manufacturer be prevented from taking employment with a competitor, especially if he has confidential information or knowledge of trade secrets?

Answered by Leo T. Parker, Attorney-at-Law
Cincinnati, Ohio

Various courts have held contracts valid, by the terms of which employes agree not to enter into competitive employment after leaving the present employer. Also, court decisions are uniform to the effect that disclosures of trade secrets by an employe, secured by him in the course of confidential employment, can be prevented by an injunction suit on the part of his former employer. However, if an employe did not contract not to accept employment with a competitor and does not make use of trade secrets or confidential information, he has a legal right to accept employment with whomsoever he wishes.

In the case of Curry v. Marquart [11 N.E. (2d) 868], an employer filed suit against a former employe to prevent him from taking employment with a competitor. However, since the employe had not contracted with his first employer not to accept competitive employment, and since it was not shown that the employe used any unfair methods, the Court refused to prohibit him from working for his new employer, for whom he was soliciting and selling to the old customers which he had served while working for his first employer.

This Court said: "This case involves no question of trade secrets or confidential information.... No well considered case has gone so far as to hold that one may be enjoined from seeking to do business with friends, though they became such in the course of, and as a result of, previous employment."

* * *

How Government Can Promote Business Recovery

Honest government interest in promotion of further recovery through industry should be reflected in a careful and frank examination of all policies and laws obstructing business development. Continual deficit spending, or adjustments in bookkeeping to hide the deficit, won't help business. Definitely heading back toward government solvency will help. Relaxation of some of the restrictions on investment will do most to restore the natural flow of money into private enterprise.

In this connection, I want to make this plea to industrialists everywhere—help your government to curtail spending by not requesting any new expenditures in your own city or state. Some of us are too prone to take a position against spending until it involves a dam or an air field or a court house in our town. Then we're for it tooth and nail. That is unfair to those in government whom we hold responsible for too much spending. Speaking bluntly, you get the kind of spending you ask for in government—and then some.—*Howard Coonley, Past-president of the National Association of Manufacturers*

* * *

Capital Goods Industries and Federal Income Taxation

A report has been prepared by the Machinery and Allied Products Institute, 221 N. LaSalle St., Chicago, Ill., relating to the effect of present provisions of Federal income taxation on the capital goods industries. The report points out certain discriminatory effects of the Federal tax laws, shows how they slow up business and employment, and gives recommendations for their correction.

Direct Method of Designing Gears for Strength

By ALFRED J. NAULT

Examples Illustrating the Application of this Method in Designing Spur, Helical, Bevel, Spiral Bevel, and Worm Gears

THE following method of designing gears for strength adheres to the Lewis formula, but does away with the usual trial-and-error method of procedure. In demonstrating, by examples, the application of this new method, gearing has been divided into three general classes as determined by the speed range and the error in tooth action allowable for each range or class. The following notation is used:

P = diametral pitch of spur gears and diametral pitch in plane of rotation for herringbone or helical gears on parallel-shaft drives.

W = tangential load on gear or pinion teeth, in pounds.

W_1 = equivalent tangential load on gear or pinion teeth having a diametral pitch of 1, in pounds.

V = pitch-line velocity of gear or pinion, in feet per minute.

V_1 = equivalent pitch-line velocity of a gear or pinion having a diametral pitch of 1, in feet per minute.

F = face width of pinion and gear, in inches.

B = face width factor = factor that is divided by diametral pitch to obtain usual face width proportion. This factor is generally taken to be from 8 to 12 with 10 being most recommended.

S = allowable unit static stress of material at zero pitch-line velocity, in pounds per square inch. This is usually taken as one-third of the ultimate strength of the material.

y = tooth form factor based on circular pitch. If the value Y based on diametral pitch is used, drop the value of π wherever it appears in the procedure. Values of y or Y may be found in most machine design handbooks or textbooks.

A = loading factor. For a steady load on a single pair of gears, $A = 1$; for a suddenly applied load on a single pair of gears, $A = 1\ 1/3$; for a steady applied load on gears of a train beyond the first mesh, $A = 1\ 2/3$; and for a suddenly applied load on gears of a train beyond the first mesh, $A = 2$.

n = number of teeth in pinion.

N = number of teeth in gear.

R = number of revolutions pinion makes per minute.

T = torque transmitted by pinion, in pound-inches.

H = horsepower transmitted by gear and pinion.

Spur Gear Velocity Range Classification and Permissible Errors for Each Class

Spur gears are divided into three classes, depending upon the accuracy desired. To decrease noise at high speeds requires more precise gears. Table 1 gives the pitch-line velocity range for each class of gear that will keep the noise down to a reasonable degree. The maximum permissible error in tooth action for each class of gear is also given. This maximum error should be specified when ordering gears.

Table 1. General Classes of Gearing and Permissible Error in Tooth Action for Each Class

Diametral Pitch	Class Number of Gearing and Velocity Range in Feet per Minute		
	Class I 0 to 1000	Class II 1000 to 2000	Class III 2000 to 4000
	Maximum Error in Tooth Action, Inch		
1	0.0048	0.0024	0.0012
2	0.0040	0.0020	0.0010
3	0.0032	0.0016	0.0008
4	0.0026	0.0013	0.0007
5	0.0022	0.0011	0.0006
6 and Finer	0.0020	0.0010	0.0005

The term "error in tooth action" means the variation in the action of two intermeshing gears, compared with that of two perfect cylinders in contact with each other, having diameters equal to the gear. The two cylinders would roll together smoothly; but two gears having an error in tooth action would be accelerated and decelerated slightly, the extent varying with the error in tooth action. The acceleration and deceleration cause impact loads on the gear teeth; therefore, the greater the error in tooth action, the greater the impact load will be, resulting in a lesser load-carrying capacity. Error in tooth action is the summation of all the individual errors; however, each

individual error may be either a minus or a plus value, and it is possible that the summation of those errors will be zero. There are various testing machines on the market that measure the errors in tooth action.

Spur Gear Design—Examples Illustrating Application of Direct Method

Example 1—Design a 21-tooth pinion and 85-tooth gear to transmit 25 H.P. The pinion speed R is to be 100 R.P.M., and the load is applied suddenly.

Given values: $H = 25$; $n = 21$; $N = 85$

Obtained from given information: $A = 1\ 1/3$

$$W_1 = \frac{2T}{n} = \frac{126{,}050H}{nR} = \frac{126{,}050 \times 25}{21 \times 100} = 1500$$

$$V_1 = 0.2618\ nR = 0.2618 \times 21 \times 100 = 550$$

Assume: 20-degree full-depth involute teeth; y for pinion = 0.104; y for gear = 0.140. Steel, S A E 1030 for pinion; $S = 20{,}000$; S A E 1235 for gear; $S = 15{,}000$. Face width factor B is to equal 10 approximately.

Determine ratio of strength of pinion to strength of gear.

Strength of pinion : Strength of gear =

$$\frac{Sy \text{ (values for pinion)}}{Sy \text{ (values for gear)}} : 1 =$$

$$\frac{20{,}000 \times 0.104}{15{,}000 \times 0.140} : 1 = 0.99 : 1$$

If the first value of the ratio is equal to or is less than 1, use the values of S and y for the pinion in the additional calculations; if it is larger than 1, use the values for the gear.

Solve for a value to be designated as K:

$$K = \frac{SB\pi y}{AW_1} = \frac{20{,}000 \times 10 \times \pi \times 0.104}{1\ 1/3 \times 1500} = 32.67$$

Solve for a value (to be designated as C) which is used in determining the pitch:

$$C = \frac{600}{600 + V_1} \times K = \frac{600}{600 + 550} \times 32.67 = 17.05$$

From Table 2, select P for values of V_1 and C of 550 and 17.05, respectively, and for Class I gears, since the pitch-line velocity evidently is in this

Table 2. Values of V_1 and C Used in Determining Diametral Pitch—Helical, Worm, Bevel, and Class I and Class II Spur Gears

	V_1													
Class I	0	100	200	300	400	600	900	1400	1900	2400	3400	4400	9400	19400
Class II	0	200	400	600	800	1200	1800	2800	3800	4800	6800	8800	18800	38800
P	C													
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1 1/4	1.95	1.90	1.86	1.82	1.80	1.76	1.72	1.68	1.66	1.64	1.62	1.61	1.59	1.58
1 1/2	3.38	3.21	3.09	3.00	2.93	2.81	2.70	2.59	2.52	2.48	2.42	2.39	2.32	2.28
1 3/4	5.36	5.03	4.79	4.59	4.44	4.21	3.98	3.75	3.61	3.52	3.41	3.34	3.19	3.13
2	8.00	7.41	7.00	6.67	6.40	6.00	5.60	5.20	4.96	4.80	4.60	4.48	4.24	4.12
2 1/4	11.39	10.49	9.81	9.28	8.86	8.23	7.59	6.96	6.58	6.33	6.01	5.82	5.44	5.25
2 1/2	15.63	14.29	13.28	12.50	11.88	10.94	10.00	9.06	8.50	8.13	7.66	7.38	6.81	6.53
2 3/4	20.80	18.90	17.50	16.40	15.50	14.20	12.90	11.50	10.70	10.20	9.50	9.20	8.40	8.00
3	27.00	24.40	22.50	21.00	19.80	18.00	16.20	14.40	13.30	12.60	11.70	11.20	10.10	9.50
3 1/2	42.90	38.50	35.20	32.70	30.60	27.60	24.50	21.40	19.60	18.40	16.80	15.90	14.10	12.20
4	64	57.10	52.00	48.00	44.80	40.00	35.20	30.40	27.50	25.60	23.20	21.80	18.90	17.40
5	125	110.7	100	91.70	85	75	65	55	49.50	45	40	37	31	28
6	216	190.3	171	156	144	126	108	90	79	72	63	58	47	41
7	343	301	270	245	225	196	166	137	120	108	93	84	67	58
8	512	448	400	363	333	288	243	198	172	154	131	118	91	77
9	729	636	567	513	470	405	340	275	237	211	179	159	120	100
10	1000	871	775	700	640	550	460	370	316	280	235	208	154	127
11	1331	1158	1029	928	847	726	605	484	411	363	303	266	194	157
12	1728	1499	1332	1198	1094	936	778	619	524	461	382	334	239	192
13	2197	1907	1690	1521	1386	1183	980	777	656	575	473	412	291	230
14	2744	2380	2107	1895	1725	1470	1215	960	808	706	578	502	349	272
15	3375	2925	2587	2325	2115	1800	1485	1170	981	855	698	603	414	320
16	4096	3547	3136	2816	2560	2176	1792	1408	1178	1024	832	717	486	371

class, as shown by Table 1. As V_1 is 550, or between 400 and 600 in Table 2, and the values of C (beneath 400—600) nearest to 17.05 are 19.8—18.0, the diametral pitch P is 3, as shown in the first column.

Check for the actual pitch-line velocity V:

$$V = \frac{V_1}{P} = \frac{550}{3} = 183.3 \text{ feet per minute}$$

From Table 1, this is found to be within the speed range of Class I gears; therefore, the diametral pitch of 3 is satisfactory.

Solve for face width F:

$$F = \frac{AW_1P^2}{S\pi y} \times \frac{600 + V}{600} =$$

$$\frac{1\ 1/3 \times 1500 \times 3^2}{20{,}000\pi \times 0.104} \times \frac{600 + 183.3}{600} = 3.597$$

Use 3 5/8 inches.

Check for face width factor B:

$B = FP = 3\ 5/8 \times 3 = 10\ 7/8$, which is satisfactory.

Example 2—Design a 21-tooth pinion and 85-tooth gear to transmit 400 H.P. The pinion speed R is 1000 R.P.M., and the load is applied suddenly.

Given values: $H = 400$; $n = 21$; $N = 85$; $R = 1000$

Obtained from given information: $A = 1\ 1/3$

$$W_1 = \frac{2T}{n} = \frac{126{,}050H}{nR} = \frac{126{,}050 \times 400}{21 \times 1000} = 2400$$

$$V_1 = 0.2618nR = 0.2618 \times 21 \times 1000 = 5500$$

Assume: 20-degree full-depth involute teeth; y for pinion = 0.104; y for gear = 0.140. Steel, S A E 1030 for pinion; $S = 20{,}000$; S A E 1235 for gear; $S = 15{,}000$. Face width factor B is to equal 10 approximately.

Determine ratio of strength of pinion to strength of gear. (See Example 1).

Solve for K:

$$K = \frac{SB\pi y}{AW_1} = \frac{20{,}000 \times 10 \times \pi \times 0.104}{1\ 1/3 \times 2400} = 20.42$$

Solve for C:

$$C = \frac{600}{600 + V_1} \times K = \frac{600}{600 + 5500} \times 20.42 = 2$$

From Table 2, select P for values of V_1 and C of 5500 and 2, respectively, and for Class I gears. $P = 1\ 1/2$.

Check for V:

Table 3. Values of V_1 and C Used in Determining Diametral Pitch—Helical and Class III Spur Gears

	V_1												
Class III	**0**	**169**	**676**	**1521**	**2704**	**4225**	**6084**	**8281**	**10816**	**13689**	**16900**	**24336**	**33124**
P	C												
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1 1/4	1.95	1.92	1.90	1.88	1.87	1.87	1.85	1.84	1.84	1.83	1.82	1.82	1.81
1 1/2	3.38	3.29	3.22	3.17	3.13	3.09	3.07	3.04	3.02	3.00	2.99	2.96	2.94
1 3/4	5.36	5.17	5.03	4.92	4.84	4.76	4.71	4.65	4.61	4.57	4.54	4.49	4.44
2	8.00	7.67	7.41	7.22	7.06	6.93	6.83	6.74	6.66	6.59	6.54	6.44	6.36
2 1/4	11.39	10.85	10.44	10.13	9.87	9.62	9.49	9.35	9.22	9.11	9.02	8.86	8.73
2 1/2	15.63	14.81	14.20	13.73	13.35	13.04	12.78	12.56	12.38	12.22	12.07	11.84	11.65
2 3/4	20.80	19.62	18.73	18.05	17.50	17.04	16.67	16.35	16.08	15.84	15.64	15.36	15.02
3	27.00	25.37	24.15	23.20	22.44	21.81	21.30	20.86	20.48	19.75	19.64	19.39	19.01
3 1/2	42.88	40.00	37.88	36.22	34.89	33.62	32.89	32.12	31.46	30.89	30.39	29.56	28.90
4	64.00	59.40	56.00	53.33	51.20	49.44	48.00	46.77	45.71	44.80	44.00	42.67	41.60
5	125	115.10	107	102	97.36	93.60	90.45	87	85.51	83.54	81.80	78.90	76.63
6	216	198	184	173	165	158	152	147	143	139	136	131	127
7	343	313	290	272	258	246	236	228	221	215	210	201	194
8	512	465	429	402	380	362	347	334	323	313	305	291	280
9	729	660	608	567	535	508	486	467	451	437	425	405	389
10	1000	902	829	772	726	699	658	632	609	590	573	544	521
11	1331	1198	1098	1021	999	908	866	830	800	773	750	711	680
12	1728	1552	1421	1318	1236	1169	1113	1066	1026	990	960	909	868
13	2197	1970	1800	1668	1562	1475	1403	1342	1290	1244	1205	1139	1086
14	2744	2457	2241	2073	1940	1830	1739	1661	1596	1537	1487	1403	1337
15	3375	3017	2749	2540	2374	2237	2123	2027	1944	1873	1810	1706	1623
16	4096	3657	3328	3072	2867	2700	2560	2442	2340	2253	2176	2048	1945

Table 4. Tooth Form Factors for 20-Degree Involute Stub Teeth

n	y	n	y	n	y
11	0.228	16	0.276	21	0.307
12	0.242	17	0.282	22	0.312
13	0.252	18	0.288	23	0.317
14	0.260	19	0.294	24	0.323
15	0.268	20	0.300	25	0.328

$$V = \frac{V_1}{P} = \frac{5500}{1\ 1/2} = 3670 \text{ feet per minute}$$

From Table 1, this is found to be beyond the speed range of Class I gears; therefore, calculations for Class II gears will be made and a higher velocity factor will be used.

Solve for C for Class II gears:

$$C = \frac{1200}{1200 + V_1} \times K = \frac{1200}{1200 + 5500} \times 20.42 = 3.66$$

From Table 2, select P for values of V_1 and C of 5500 and 3.66, respectively, and for Class II gears. $P = 1\ 3/4$.

Check for V:

$$V = \frac{V_1}{P} = \frac{5500}{1\ 3/4} = 3140$$

From Table 1, this is found to be beyond the speed range of Class II gears; therefore, calculations for Class III gears will be made and the velocity factor again will be increased. If the speed range does fall within Class II gears, solve for F $\left(F = \frac{AW_1P^2}{S\pi y} \times \frac{1200 + V}{1200}\right)$ and check value of B, as in Example 1.

Solve for C for Class III gears:

$$C = \frac{78}{78 + \sqrt{V_1}} \times K = \frac{78}{78 + \sqrt{5500}} \times 20.42 = 11.84$$

From Table 3, select P for values of V_1 and C of 5500 and 11.84, respectively. $P = 2\ 1/4$.

Check for V:

$$V = \frac{V_1}{P} = \frac{5500}{2\ 1/4} = 2444 \text{ feet per minute}$$

Solve for F:

$$F = \frac{AW_1P^2}{S\pi y} \times \frac{78 + \sqrt{V}}{78} =$$

$$\frac{1\ 1/3 \times 2400 \times 2\ 1/4^2}{20{,}000 \times \pi \times 0.104} \times \frac{78 + \sqrt{2444}}{78} = 4.05$$

Use 4 1/8 inches.

Check for B:

$B = FP = 4\ 1/8 \times 2\ 1/4 = 9\ 9/32$, which is satisfactory.

The great majority of references on gear design list all three velocity factors used in the preceding examples. The factor $\frac{600}{600 + V}$ is used for ordinary commercial gears, $\frac{1200}{1200 + V}$ for carefully cut gears, and $\frac{78}{78 + \sqrt{V}}$ for extremely accurate gears running at high speeds. These references, however, do not state what the accuracy of the gears designed by each velocity factor should be. Table 1, giving the maximum permissible error in tooth action, which is in Buckingham's "Manual of Gear Design" and has been recommended by the A.G.M.A., provides the necessary accuracy. The majority of commercial gears are within the accuracy of Class I gears in Table 1.

Gears having the accuracy of tooth action given under Class II in Table 1 are carefully cut gears, and those in Class III are extremely accurate gears. It is mostly a matter of personal opinion as to what limit of pitch-line velocity should be used under each class of gear. At low pitch-line velocity there is little, if any, advantage in using accurately cut gears. However, as the speed increases, the acceleration and impact loads caused by the error in tooth action increase. Therefore, there is some value of the pitch-line velocity where it is economical and advantageous to use more accurately cut gears.

Design of Helical and Herringbone Gears

In illustrating the direct method of designing as applied to helical or herringbone gears, the same notation will be used as for spur gears, except for the following modifications or changes:

S = allowable unit stress of material at zero pitch-line velocity, as before. This value, however, is usually equal to the elastic limit of the material divided by 4 for forged steel; the elastic limit divided by 5 for cast steel; the ultimate tensile strength divided by 6 for cast iron; and the ultimate tensile strength divided by 7 for bronze.

y = tooth form factor for 20-degree involute stub teeth, which is the most commonly used tooth for helical and herringbone gears. Values of y up to 25 teeth may be taken from Table 4, and those for more than 25 teeth are computed from the equation $y = 0.477 - \frac{3.7}{n}$.

B = face width factor; but for helical gears this factor usually ranges from 8 to 1 1/2n, and for herringbone gears having a helix angle of 30 degrees it ranges from 12.5 to 2n. For herringbone gears having a helix angle other than 30 degrees, the minimum value of B is taken to be equal to $\frac{7.22568}{\tan (\text{helix angle})}$. The upper limit of B for both types of gears is for pinions having 20 or less teeth.

E = wear factor. This factor is 0.25 for unenclosed grease-lubricated gears, and 0.4 for enclosed properly lubricated gears.

Example 3—Design a 21-tooth herringbone pin-

ion and 101-tooth herringbone gear to transmit 400 H.P. The gears are to be fully enclosed and properly lubricated, and the pinion speed R is to be 1000 R.P.M.

Given values: $H = 400$; $n = 21$; $N = 101$; $R = 1000$.

Obtained from given information: $E = 0.4$

$$W_1 = \frac{2T}{n} = \frac{126{,}050H}{nR} = \frac{126{,}050 \times 400}{21 \times 1000} = 2400$$

$$V_1 = 0.2618nR = 0.2618 \times 21 \times 1000 = 5500$$

$y = 0.307$ for pinion from Table 4, and

$$y = 0.477 - \frac{3.7}{101} = 0.440 \text{ for gear.}$$

Assume: Steel, S A E 1045, elastic limit of 40,000 pounds per square inch, $S = 10{,}000$ for pinion.

A.S.T.M. Class B cast steel, elastic limit of 37,500 pounds per square inch, $S = 7500$ for gear.

$$B = 1\ 1/2n = 1\ 1/2 \times 21 = 31.5$$

Determine ratio of strength of pinion to strength of gear.

Strength of pinion: Strength of gear =

$$\frac{Sy \text{ (values for pinion)}}{Sy \text{ (values for gear)}} : 1 = \frac{10{,}000 \times 0.307}{7500 \times 0.440} : 1 = 0.99 : 1$$

If the first value of the ratio is equal to or less than 1, use the values of S and y for the pinion; and if it is more than 1, use the values of S and y for the gear in the additional calculations.

Solve for K:

$$K = \frac{ESB\pi y}{W_1} = \frac{0.4 \times 10{,}000 \times 31.5 \times \pi \times 0.307}{2400} = 50.64$$

Solve for C:

$$C = \frac{78}{78 + \sqrt{V_1}} \times K = \frac{78}{78 + \sqrt{5500}} \times 50.64 = 25.95$$

From Table 3, select P for values of V_1 and C of 5500 and 25.95, respectively. $P = 3$.

Solve for pitch-line velocity V:

$$V = \frac{V_1}{P} = \frac{5500}{3} = 1833 \text{ feet per minute}$$

Solve for face width F:

$$F = \frac{W_1P^2}{ES\pi y} \times \frac{78 + \sqrt{V}}{78} = \frac{2400 \times 3^2}{0.4 \times 10{,}000 \times \pi \times 0.307} \times \frac{78 + \sqrt{1833}}{78} = 8.83$$

Use 8 7/8 inches.

Check for face width factor B:

$$B = FP = 8\ 7/8 \times 3 = 26\ 5/8$$

Example 4—Same as Example 3, except a velocity factor of $\frac{3000}{3000 + V}$ is to be used in place of $\frac{78}{78 + \sqrt{V}}$ used in Example 3. All steps will be the same as in Example 3 up to the solving for C.

$$C = \frac{3000}{3000 + V_1} \times K = \frac{3000}{3000 + 5500} \times 50.64 = 17.88$$

As Table 2 for Class I gears has been calculated for a velocity factor of $\frac{600}{600 + V_1}$, in using this table for helical gears, velocity factor $\frac{3000}{3000 + V_1}$ must be divided by 5, which equals $\frac{600}{600 + \frac{V_1}{5}}$.

As we only require V_1 in using the table, divide V_1 by 5. $\frac{V_1}{5} = \frac{5500}{5} = 1100$, which is the value of V_1 to be used in referring to Class I gears in Table 2. Then, from this table, we find $P = 3$.

Solve for V:

$$V = \frac{V_1}{P} = \frac{5500}{3} = 1833 \text{ feet per minute}$$

Solve for F:

$$F = \frac{W_1P^2}{ES\pi y} \times \frac{3000 + V}{3000} = \frac{2400 \times 3^2}{0.4 \times 10{,}000 \times \pi \times 0.307} \times \frac{3000 + 1833}{3000} = 9.02$$

Use 9 inches.

Check for B:

$$B = FP = 9 \times 3 = 27$$

Non-Metallic Spur Gears

Non-metallic spur gears are best suited for steady loads at comparatively high speeds. Table 5 was developed for velocities of 600 feet per minute and higher. The allowable unit stress S of the material at zero pitch-line velocity usually equals 6000 for non-metallic materials. The tooth form factor $y = 0.175 - \frac{1}{n}$ for 20-degree stub involute teeth, which is the most commonly used tooth standard for non-metallic spur gears.

Example 5—Design a 21-tooth non-metallic pinion and an 85-tooth cast-iron gear to transmit 25 H.P. The pinion speed R is 1000 R.P.M.

Given: $H = 25$; $n = 21$; $N = 85$; $R = 1000$

Obtained from given information:

$$y = 0.175 - \frac{1}{n} = 0.175 - \frac{1}{21} = 0.127$$

$$W_1 = \frac{2T}{n} = \frac{126{,}050H}{nR} = \frac{126{,}050 \times 25}{21 \times 1000} = 150$$

$$V_1 = 0.2618nR = 0.2618 \times 21 \times 1000 = 5500$$

Assume that face width factor B is to equal 10 approximately.

Solve for K:

$$K = \frac{SB\pi y}{W_1} = \frac{6000 \times 10 \times \pi \times 0.127}{150} = 159.6$$

Solve for C:

$$C = \left(\frac{150}{200 + V_1} + 0.25 \right) \times K =$$

$$\left(\frac{150}{200 + 5500} + 0.25 \right) \times 159.6 = 44.1$$

From Table 5, select P for values of V_1 and C of 5500 and 44.1, respectively. $P = 4$.

Check for V:

$$V = \frac{V_1}{P} = \frac{5500}{4} = 1375 \text{ feet per minute}$$

Solve for F:

$$F = \frac{W_1 P^2}{S\pi y} \times \frac{200 + V}{200 + 0.25V} =$$

$$\frac{150 \times 4^2}{6000 \times \pi \times 0.127} \times \frac{200 + 1375}{200 + 0.25 \times 1375} = 2.99$$

Use 3 inches.

Check for B:

$$B = FP = 3 \times 4 = 12$$

Straight-Tooth and Spiral Bevel Gears

Spiral bevel gears are stronger than straight-tooth bevel gears, but in designing for strength they are considered equal. The result is that spiral bevel gears are designed with a larger factor of safety than straight-tooth bevel gears. Straight-tooth and spiral bevel gears are designed in the same manner as spur gears, as shown by Example 1, with the following exceptions:

(1) In selecting the value of y from a table for spur gears, divide the actual number of bevel-gear teeth by the cosine of the pitch-cone angle to obtain the number of teeth upon which y is based.

(2) Factor B either ranges from 5 to 8 or is equal to $\frac{n}{8 \sin a}$, depending upon the conditions (a equals the pitch-cone angle of the pinion). If $\frac{n}{8 \sin a}$ is less than or equal to the value selected from the 5 to 8 range, use the formula value of $\frac{n}{8 \sin a}$ for B. If the formula value is larger than the value selected from the 5 to 8 range, use the latter value.

(3) $K = \frac{3SB\pi y}{4AW_1}$ when $B = \frac{n}{8 \sin a}$

$K = \frac{SB\pi y}{AW_1} \times \left(1 - \frac{2B \sin a}{n}\right)$ when B does not equal $\frac{n}{8 \sin a}$

(4) $C = \frac{1200}{1200 + V_1} \times K$

Table 5. Values of V_1 and C Used in Determining Diametral Pitch—Non-Metallic Gears

P	V_1												
	600	700	800	900	1000	1200	1600	2000	3000	6000	10000	20000	40000
	C												
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1 1/4	1.81	1.82	1.83	1.83	1.84	1.84	1.85	1.86	1.88	1.91	1.93	1.94	1.95
1 1/2				2.98	2.99	3.01	3.05	3.09	3.15	3.24	3.29	3.33	3.35
1 3/4					4.52	4.56	4.64	4.71	4.85	5.04	5.15	5.25	5.30
2						6.53	6.67	6.79	7.02	7.39	7.59	7.78	7.89
2 1/4						7.90	8.19	9.35	9.72	10.33	10.68	11.00	11.19
2 1/2						10.54	10.94	12.43	12.99	13.92	14.48	14.99	15.29
2 3/4							14.35	16.07	16.86	18.22	19.04	19.82	20.42
3							18.00	20.31	21.38	23.27	23.98	25.57	26.22
3 1/2								30.70	32.48	35.80	37.95	40.08	41.38
4								43.86	46.58	51.88	55.44	59.08	61.35
5									84.82	95.97	105	113	118
6									138	161	173	190	202
7									208	240	265	295	316
8									298	344	383	431	466
9									407	472	530	602	655
10										627	706	809	888
11										809	915	1056	1168
12										1020	1158	1346	1508
13										1264	1437	1682	1885
14										1540	1754	2065	2326
15										1817	2112	2498	2833
16										2153	2511	2983	3401

(5) Use Table 2 for Class II gears in selecting P.

(6) $F = \frac{4AW_1P^2}{3S\pi y} \times \frac{1200 + V}{1200}$ when $B = \frac{n}{8 \sin a}$

$$F = \frac{AW_1P^2}{S\pi y} \times \frac{n}{n - 2B \sin a} \times \frac{1200 + V}{1200}$$

when B does not equal $\frac{n}{8 \sin a}$

Worm-Gears

Worm-gears are designed for strength in the same manner as spur gears, as shown by Example 1, with the following exceptions:

(1) The A.G.M.A. recommends that the pitch diameter of the worm shall be equal to (2.4 × linear pitch + 1.1); the face width of a single- or double-threaded worm-gear shall be equal to (2.38 × linear pitch + 0.25); and the face width of a triple- or quadruple-threaded worm-gear shall be equal to (2.15 × linear pitch + 0.20). If these recommendations are to be followed, use 7.2 for the value of B for single- or double-threaded worms, and 6.75 for triple- or quadruple-threaded worms.

(2) It is not necessary to determine the ratio of the strength of the worm-gear to the worm, as the worm is always the stronger.

(3) $C = \frac{1200}{1200 + V_1} \times K$

(4) Use Table 2 for Class II gears in selecting P. When the value of C falls between two values of P, use the smaller value of P.

(5) For single- and double-threaded worms,

$$F = 2.38 \times \text{linear pitch} + 0.25 = \frac{2.38 \times \pi}{P} + 0.25$$

For triple- and quadruple-threaded worms,

$$F = 2.15 \times \text{linear pitch} + 0.20 = \frac{2.15 \times \pi}{P} + 0.20$$

* * *

Crane Brake Wheels Made of Meehanite

Heavy-duty crane brake wheels are now being cast from Meehanite metal as a result of recent experiments undertaken by the Meehanite Research Institute, in cooperation with the Meehanite foundries throughout the country. The material used is "GA Meehanite" which has a minimum tensile strength of 50,000 pounds per square inch and a Brinell hardness of about 220. The service records of these wheels indicate that they show little distortion from severe usage and frictional heat, and the wheel surface does not glaze with continued use—hence there is no reduction in gripping power. The brake acting on these wheels is a cast steel shoe with an asbestos compound lining.

Pratt & Whitney Aircraft Celebrates Fifteenth Anniversary

August 1 marked the fifteenth birthday of the Pratt & Whitney Aircraft Division of the United Aircraft Corporation. It was on that date, in 1925, that F. B. Rentschler, D. L. Brown, and G. J. Mead undertook the design and construction of a 400-H.P. radial air-cooled aircraft engine for the Bureau of Aeronautics of the U. S. Navy. With a small group of twenty-five people, they began work in one of the buildings of the Pratt & Whitney machine tool factory at Hartford, Conn. Within less than half a year, the first of the now famous Wasp engines had been completed; it held the distinction of being more powerful than any comparable engine at that time. The Navy immediately ordered six experimental engines, and another order for 200 soon followed.

From that time, the growth of the Pratt & Whitney Aircraft has been swift. Within five years 1300 workers were employed in the newly completed 400,000 square-foot structure at East Hartford. Today, the Pratt & Whitney aircraft plant covers more than 1,250,000 square feet and employs 10,000 men and women on a three-shift basis.

The plant is still expanding. Two months ago, work was begun on another plant addition designed to increase the monthly engine output to 1,200,000 H.P. The plans call for the beginning of production in the new plant by the end of this year.

* * *

The Man Over Forty is Welcome at Disston's

The cause of the older man in industry was recently championed by S. Horace Disston, president of Henry Disston & Sons, Inc., Philadelphia, Pa. "We do not think of a man in terms of his age," said Mr. Disston; "we are interested in his skill, ability, and character. We need men who are careful and patient, and who understand that many of our products are made with precision-tool accuracy. We do not tell a man that he is through at forty or fifty; he is just growing ripe at that age."

Mr. Disston pointed out that a service award was recently made to George Metzger, eighty-three years old, who has worked for the company for seventy years. He is still foreman of the company's blacksmith shop. Six employes have been with the company for sixty years or more, and forty-nine for fifty years or more. One-fourth of all the company's employes have been with the firm for more than twenty years.

Another interesting fact about the Disston plant is the number of people from the same family that are working for the concern. There are seven three-generation groups, consisting of grandfather, father, and son, represented.

Chart for Determining Machine Production

By L. DE L. BERG

A rapid method for determining the hourly production of automatic or semi-automatic machines is provided by the accompanying chart. It can be used for all types of machines when the complete cycle required to produce one piece is timed in seconds, as in the case of screw machines, or when the cycle is timed in revolutions per minute, as in the case of punch presses, headers, thread rollers, etc. In figuring the hourly output of such machines, the operating efficiency over a long run always enters into the calculation. The efficiency of automatic roll-fed power presses may run as high as 80 to 85 per cent, whereas that of a screw machine working on tough alloy steel that requires frequent tool grinding and adjustments may be only 60 per cent. The operating efficiency of the machine for different types of work is generally known by the production or estimating departments from a study of past performances.

To use the chart, a straightedge is laid across it so that the edge intersects the scales representing the efficiency of the machine and the time required to produce one piece (or revolutions per minute, as the case may be) at the figures for which the calculation is to be made. The result is then read in the column headed "Pieces Made in One Hour." A convenient straightedge for use with the chart consists of a piece of clear celluloid, on which a fine line has been scratched.

As an example illustrating the use of the chart, assume that an automatic screw machine completes one piece every 9 1/2 seconds. The machine, allowing for refilling, tool sharpening, and adjusting,

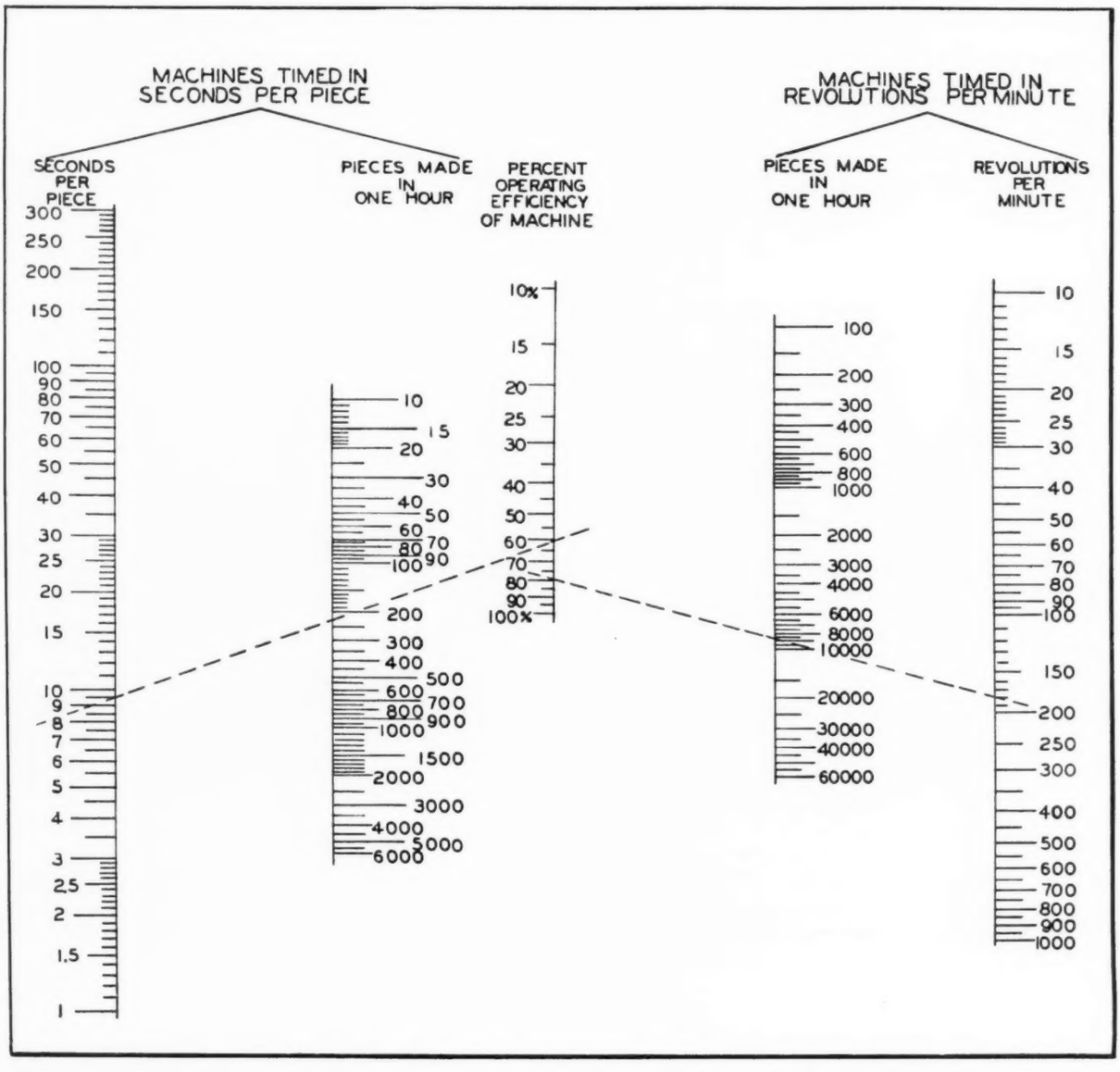

MACHINES TIMED IN SECONDS PER PIECE
SECONDS PER PIECE
PIECES MADE IN ONE HOUR
PERCENT OPERATING EFFICIENCY OF MACHINE
MACHINES TIMED IN REVOLUTIONS PER MINUTE
PIECES MADE IN ONE HOUR
REVOLUTIONS PER MINUTE

Chart for Finding Production of Machine Timed in Seconds or Revolutions per Minute

operates at an average efficiency of 60 per cent. To find the number of pieces the machine will produce in an hour, lay the straightedge or scribed line of the piece of celluloid across the three left-hand scales so that it intersects the "Seconds per Piece" scale at 9.50 and the "Per Cent Efficiency" scale at 60, as indicated by the dotted line. It will then be seen that the scale "Pieces Made in One Hour" is intersected at 225, which will be the approximate number of pieces made in one hour. By the same method, it will be seen that a punch press running at 180 revolutions per minute and operating at 80 per cent efficiency will produce slightly less than 9000 pieces per hour, as indicated by the dotted line at the right.

* * *

Repairing Broken Broach by Brazing

A high-speed broach used in cutting 3/8-inch keyways was broken recently at the plant of the S & S Corrugated Paper Machinery Co., Inc., Brooklyn, N. Y. This tool is in constant use on a variety of work. To replace it necessitated an expenditure of $72.75, but the delay involved was a more serious matter than the cost, as it meant disrupting production schedules.

In order to avoid delay, the service department of one of the largest welding equipment manufacturers was called in to handle the repair job. An inspection showed that the break was clean and about 14 inches from the draw-bar end by which the broach is attached to the machine. The broach was made from air-quenched, high-speed steel. In making the repair, it was necessary to avoid methods that would affect the hardness of the broach teeth. It was also essential that the method used should avoid any change in the size of the broach and provide against warping or changing shape.

With these requirements in mind, it was decided to join the broken pieces by brazing with a low-temperature silver alloy known as "Easy-Flo," made by Handy & Harman, 82 Fulton St., New York City. This brazing alloy flows freely at a temperature of 1175 degrees F. and was used to join two reinforcing strips of tool steel to the sides of the broach, as shown in the accompanying illustration.

The sides of the broach were undercut 1/8 inch for a distance of 1 3/4 inches on both sides of the break by using a surface grinder. These undercut surfaces were then cleaned thoroughly and covered with "Handy Flux," which is completely liquid and active at 1100 degrees F. Two high-speed steel reinforcing strips *A* were formed to fit the recesses cut in the sides of the broach. The flux was then applied to these pieces. The joint was assembled with inserts of the "Easy-Flo" brazing alloy in sheet form 0.005 inch thick between the reinforcing strips and the body of the broach. The assembly was then clamped securely together.

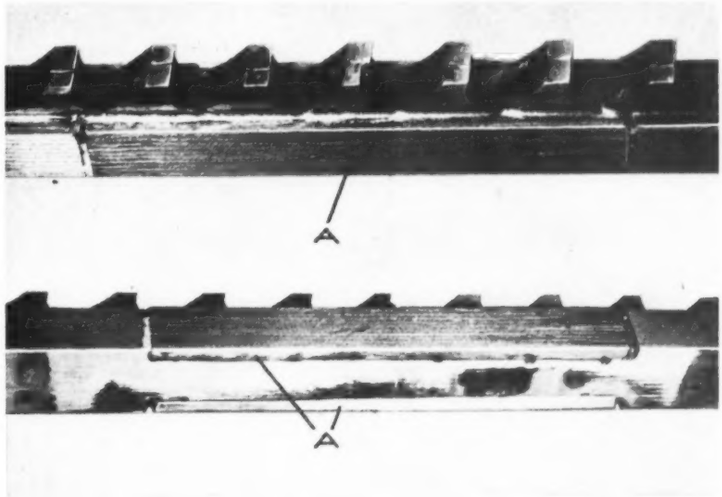
Using an oxy-acetylene torch having a No. 5 tip and regulated to a soft reducing flame, heat was applied to the side opposite the cutting teeth. Care was taken to heat evenly until a faint red appeared in the metal. The brazing-alloy insert then flowed and penetrated into the fracture. This securely joined the broken parts which had been butted together closely and united the reinforcing pieces on each side of the broach. The broach was allowed to cool in the air.

An inspection of the finished job showed a sound joint, and tests indicated that the hardness of the metal had not been affected. The broach did not warp to a harmful degree, the slight warping that did occur being attributed to quick assembly clamping methods which can be easily corrected for any future job. After slight finish-grinding, the broach was tested in regular service. It has now been in use for over three months.

In checking over the cost of the materials and labor required for the repair, it was found that $4 was paid for under-cut grinding, 50 cents for gases, 10 cents for brazing alloy and flux, $1 for brazing, and $1 for finishing, making a total of $6.60. Thus, low-temperature brazing not only relieved a production jam, but saved the difference between $72.75 and $6.60 in tool costs.

* * *

The orders booked by the Westinghouse Electric & Mfg. Co. for the twelve months ended June 30, 1940, were the highest for any twelve months in the history of the company. The value of the orders was about $245,250,000, an increase of 38 per cent over the preceding twelve-month period.



Broken Broach Repaired by Brazing Strips A in Recesses Ground in Sides of Body

Extrusion Press for Stainless Steel

A Press of 2000 Tons Capacity has been Developed for the Extrusion of Stainless Steel, Ferrous and Non-Ferrous Tubing and Rods

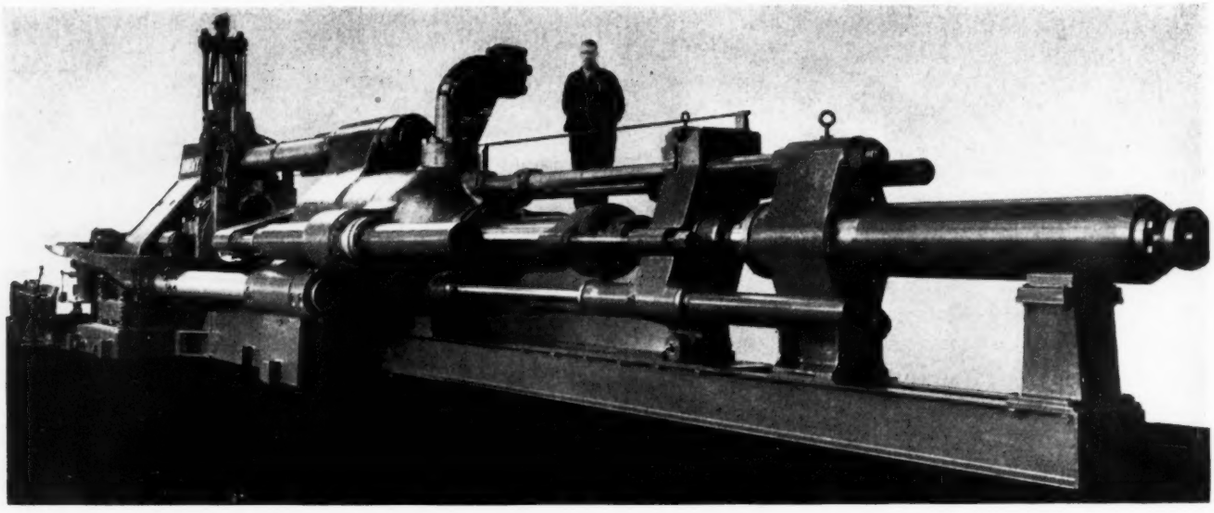
WHILE the process of extruding non-ferrous metals has been employed for thirty-five years, it is only during the last few years that this method has been successfully applied to the production of stainless steel, nickel alloy, and ferrous rods, tubing, and shapes. This development, which appears likely to open new fields for special alloys, has been made possible by the hydraulic extrusion press. A press of this type, of 2000 tons capacity, built by the Farrel-Birmingham Co., Inc., Ansonia, Conn., is shown in the accompanying illustration.

The designers believe that, with this new press, all the currently known stainless steels and other special ferrous and non-ferrous alloys that do not work well by rolling, welding, or piercing, can be extruded without difficulty.

The advantage of extrusion over rolling and drawing is that any part extruded from a billet has a grain structure that is more likely to be free from faults than when produced by rolling. This change in structure is due to the fact that extrusion is a squeezing-compression process, whereas rolling and drawing are stretching operations. There are many special alloys that cannot be successfully rolled at all without developing serious faults that render them unfit for certain commercial purposes. It is possible to draw extruded tubes to a final diameter of a few thousandths inch, for use as hypodermic needles, for example. The tubes thus drawn have nearly a perfect structure.

With this new press, aluminum alloys are also extruded in numerous semi-finished shapes that are readily worked to the required dimensions. The billets to be extruded can be taken in the rough-cast form, as they come from the foundry, after having been cut to the proper length. The outer surface or skin of the billets which is formed mostly by oxidation remains as a thin shell in the container after extrusion; thus the extruded product is formed of clean material only. This is particularly important in the manufacture of many high-quality products.

Tubes and rods made by this press are sound in structure and possess excellent metallurgical and physical properties. They have a good surface condition, and consequently, the number of finish-drawing operations can be considerably reduced. The amount of scrap—consisting of the thin shell of the billet and the discard—is very low; the difference between the weight of the billets and that of the extruded product is only 8 to 10 per cent in the case of tubes, and about 10 to 12 per cent in the case of rods. The concentricity of extruded tubes is well within the commercial limits; and provided that sound billets, uniformly treated, are extruded, it will be within plus or minus 5 per cent of the wall thickness.



Farrel-Birmingham 2000-ton Press for Extruding Stainless Steel, Ferrous, and Non-ferrous Tubing and Rods

Dies for Bending Brass Channels to Rectangular and Hexagonal Shapes

By W. RICHARDS

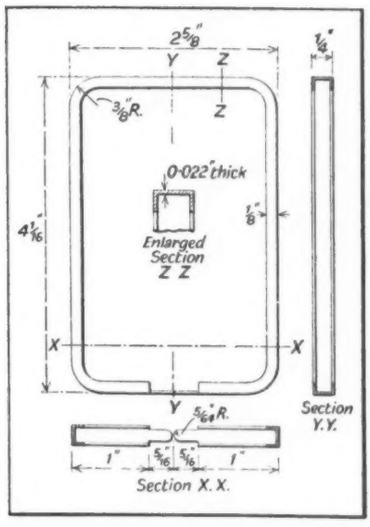


Fig. 1. Rectangular Mirror Frame Made from Channel Brass

THE bending of brass channel stock into a rectangular shape, as shown in Fig. 1, for use as mirror frames can be accomplished by various methods. One consists of forming the frames in a lathe equipped with a forming plate and roller, as described in September, 1939, MACHINERY, page 31. Another method is to use a rotary device designed to wind the channel stock into a rectangular coil, which can be cut off and notched to form the separate frames. A four-slide automatic strip-forming machine can also be used for this purpose.

The chief difficulty to be overcome in connection with these methods is the removal of the formed work from the internal forming member of the device or machine. If very large quantities of frames are required, it might be well to investigate the possibilities of the four-slide automatic forming machine.

With the die method described and illustrated in this article, the frames are formed by combined bending and drawing, without danger of distortion. The dies, as shown, are of simple design and easy to construct. Their first cost and the upkeep cost are low. When the frames are to be produced in moderate quantities, the use of dies like the ones described will prove more economical than the other methods referred to, which are better suited to large-scale production.

The frame shown in Fig. 1 is produced in two bending operations, the die for the first operation being shown in Fig. 2. The bolster *B* of this die is an iron casting, grooved to receive the punch member *A*, which is a plain blade of hardened tool steel. This member is held in position by three accurately fitted dowels. The work is located by the punch, the endwise position being determined by two angle-irons *C*.

The angle-irons are slotted so that they can be adjusted to suit the length of the work, which should, of course, be held within specified limits. The upper member of the die is also of simple construction. A cast-iron holder *D* is grooved to receive the two long side die sections *E*. These sections are of tool steel, hardened, ground, and polished on the inside faces and on the mouth radii. The sections *E* are secured by a series of screws, as shown. Two shorter die sections *F*, made of tool steel, hardened, ground, and polished on their working faces and mouth radii, are secured by screws and dowels. These sections *F* actually perform the bending operation.

A pressure pad *G*, of hardened tool steel, also ground all over, is actuated by four compression springs, acting through the pins *H*. The reaction of the springs is taken by plugs screwed into the bolster *D*. The pressure pad prevents the work from slipping during the operation, and functions as an

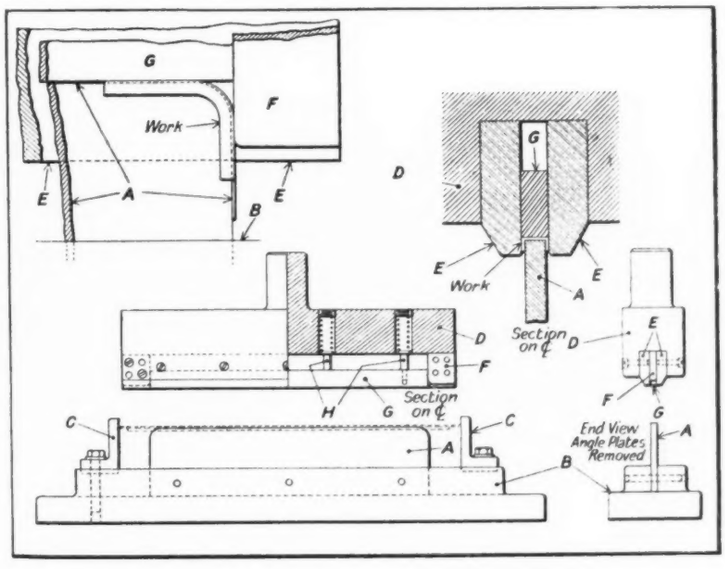


Fig. 2. Die for First Bending Operation on Rectangular Frame

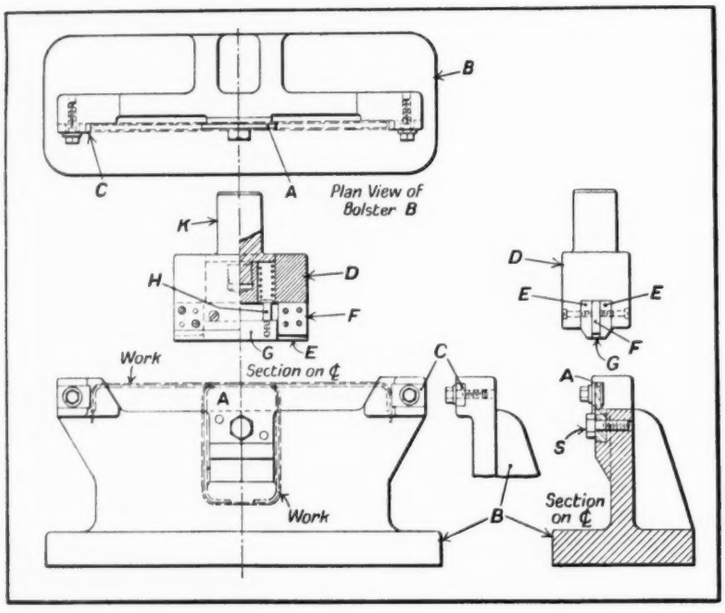


Fig. 3. Die for Second Bending Operation on Rectangular Frame

ejector, the formed part being left on the punch *A*. The die sections *F* are made shorter than the members *E*. Thus, in operation, the work is first held down securely by the pressure pad *G*, and then completely enveloped before bending takes place, the conditions being clearly shown in the enlarged sectional view taken through the center line.

The conditions at the completion of the down stroke are indicated in the enlarged view at the left-hand upper corner of Fig. 2. From this view it will be apparent that the whole of the material under process is completely enveloped, so that buckling, or distortion, cannot occur.

The die side members *E* have a drawing effect upon the material, forming the sides of the channel. The space between the members *E* should be about 0.005 inch plus *A* plus double the thickness of the channel material. This holds good for all the dies described in this article.

The tool for the second bending operation on the rectangular frame is shown in Fig. 3. Its construction follows the same principle as the die shown in Fig. 2, and all the remarks referring to grinding and to the polishing of the working surfaces previously made apply to this and all other dies here shown.

Referring to Fig. 3, the bolster *B* is a substantial iron casting, in which is fitted the punch member *A*, the latter being secured and located by a screw and dowels. The shape and length of the punch member *A* are such that the work is easily removed by slight springing after the forming operation.

The work is located by means of two plates *C*, secured by screws. Slight adjustment for length can be effected by the means indicated. The upper member is constructed on the same lines as the upper member of the die shown in Fig. 2. In this instance, however, the compression springs are retained by means of a flange on the inserted screwed stem *K*. In operation, the same pressure and enveloping features are obtained as in the tool previously described.

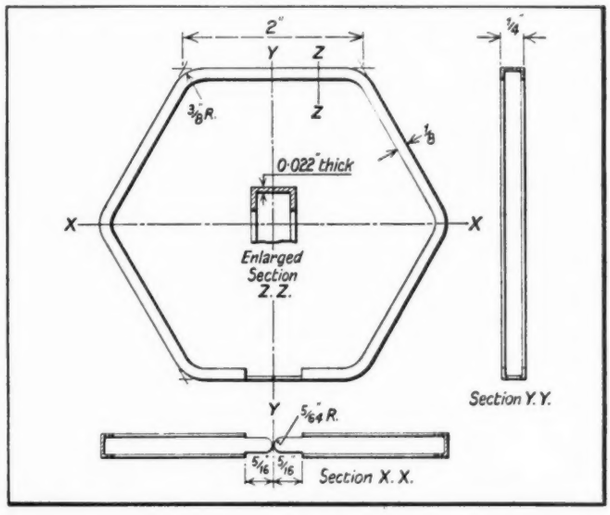


Fig. 4. Hexagonal Frame Made from Brass Channel

It is very important that the locating members *C* should be accurately adjusted. The work must be exactly central with the punch *A*, as this deter-

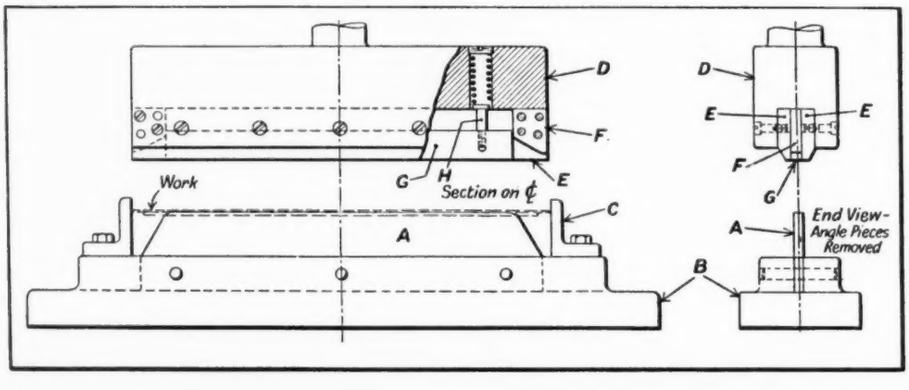


Fig. 5. Die for First Bending Operation on Hexagonal Frame

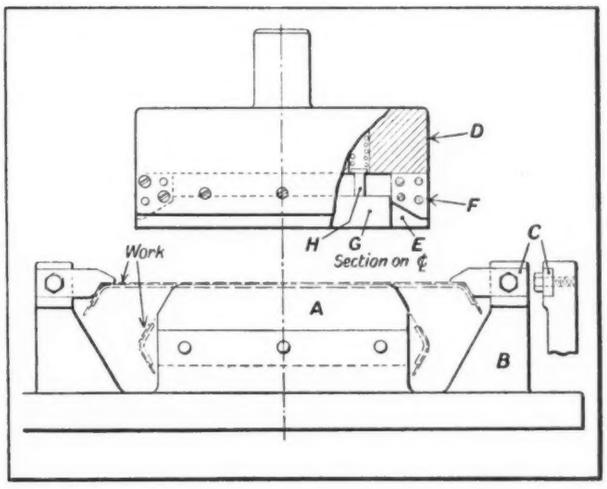


Fig. 6. Die for Second Bending Operation on Hexagonal Frame

mines the equality of the length of the two long sides of the frame, and consequently the appearance of the finished work.

To produce the hexagonal frame shown in Fig. 4, three bending operations are necessary, the dies being designed on the same lines as those used for the rectangular frame. The tool for the first bending operation is shown in Fig. 5. The punch member *A* is a plain blade, shaped to impart the required angle and corner arc to the work. The angle, in this case and in the tools to be described subsequently, may be modified to meet any springing of the material after the forming operation. The pressure pad *G* and the die side members *E* are arranged as in the previous designs, but the die end plates *F* are shaped, as shown, to give the requisite angle to the work. It will be noted that here, again, the channel is under pressure, and is also completely enveloped before bending commences. All details of the construction not specifically mentioned are the same as in the previous examples.

The second-operation bending die is shown in Fig. 6, the various members being similar to but shorter than those of the die seen in Fig. 5. The bolster *B* of the lower member is made deeper, as shown, to give clearance for the previously bent ends of the work, indicated by dotted lines. The accurate location of the work is of the utmost importance, and in this instance, the work is sprung lightly in order to position it on the tool. The peculiar form of the locating plates *C* is necessitated by the condition that the rounded ends of the work are the most reliable points for use in locating.

The third and final bending operation is performed on the die shown in Fig. 7. The lower member of this die consists of the substantial cast-iron bolster *B*, which carries the punch member *A* in a manner similar to that shown in Fig. 3. The shape and depth of the punch permit of easy removal of the work after forming. The locating plates *C* are arranged exactly the same as in the tool shown in Fig. 6. The upper member is shorter, but similar to that shown in Fig. 6. The pressure pad *G* is actuated by a single spring somewhat stiffer than those used in the dies previously described. The spring is arranged to pass through the stem *K*, and is retained in position within the holder *D* by means of a special plug.

* * *

Armour and Lewis Institutes Merge

The Armour Institute of Technology and the Lewis Institute have been merged under the name of the Illinois Institute of Technology, and will be located at Chicago, Ill. Henry T. Heald, for the last two years president of the Armour Institute of Technology, will serve as president of the new institution of engineering and scientific education. James D. Cunningham, who for seven years has been chairman of the board of trustees of the Armour Institute of Technology, has been elected chairman of the board of the new institution. Alex D. Bailey, who for many years has been chairman of the board of the Lewis Institute, has been elected vice-chairman of the board of the Illinois Institute of Technology.

Mr. Heald first became connected with the Armour Institute in 1927. He was trained not as an educator but as a civil engineer in field work, and was employed as assistant professor of civil engineering. In 1931, he became associate professor of civil engineering and assistant dean of the Institute. In 1934, he was appointed professor of civil engineering and dean. In 1937, he was made acting president, and the following year became president. Mr. Heald is only thirty-five years old, and is the youngest president in the United States of so large an educational institution.

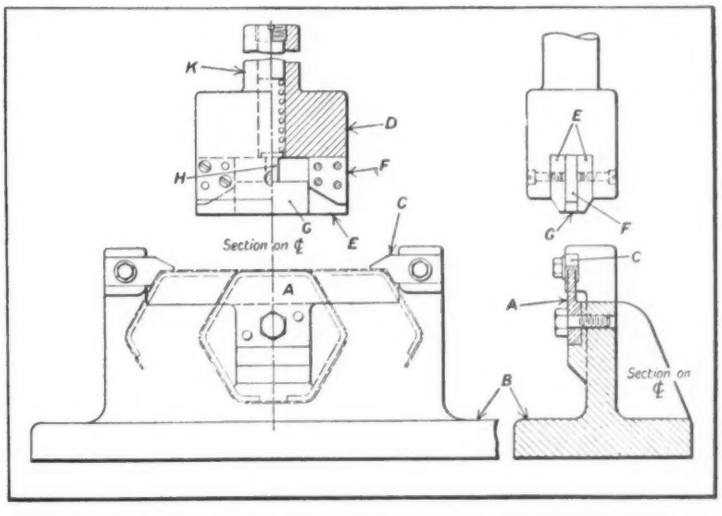


Fig. 7. Die for Final Bending Operation on Hexagonal Frame

Machining Heat-Treated Alloy Steels

Heat-Treated Alloy Steels Having a Hardness up to 500 Brinell are Now Being Satisfactorily Machined by the Use of High-Speed Steel Tools

NICKEL-chromium-molybdenum steels such as S A E 4340 or similar types are now being machined successfully on a commercial basis after being heat-treated to a hardness of 450 Brinell or higher by the use of conventional high-speed steel cutting tools in modern machines built for smooth operation under heavy loads. Until recently, the upper limit of hardness for commercial machinability has been considered to be about 350 to 375 Brinell under normal conditions. Accordingly, parts have been designed with this maximum limit in mind. For parts requiring greater hardness, it has been the practice to perform the machining operations prior to heat-treatment.

When large amounts of metal must be removed with maximum speed and efficiency, machining prior to heat-treatment while the steel is in a relatively soft condition is undoubtedly the most economical practice. Nevertheless, under certain circumstances, machining before heat-treatment has inherent disadvantages. Distortion and warpage accompany heat-treatment, and while their effects may be minimized, complete elimination of dimensional changes cannot be achieved. Consequently, it is usually necessary to resort to straightening operations after heat-treatment, or to allow for possible warpage and then grind or otherwise finish the part to the required dimensions after hardening.

Either of these procedures may have undesirable effects. The straightening operation may introduce detrimental strains in the finished part. Finishing subsequent to heat-treatment requires additional setting up and re-aligning of the part in a machine tool. This may affect the dimensional accuracy if the surfaces ground in the final operation must be accurately positioned with respect to surfaces finished prior to heat-treatment. The danger of stresses resulting from the quenching operation must also be considered. Thus, any process or method that permits the economical machining of heat-treated steel at high hardness levels has great advantages.

Heavy-duty truck axle shafts, for example, are produced from S A E 4340 steel and splined on a hobbing mill at a hardness of 400 to 444 Brinell to avoid the necessity for an additional heat-treatment of the splined end after machining. The cutter speed for this operation is 72 R.P.M., with a feed of 0.0057 inch per revolution and a surface speed of 84 feet per minute. An average of 46 pieces per cutter grind is obtained. In certain cases, the shaft has been machined satisfactorily at reduced speeds and feeds after the hardness has been increased to 500 Brinell.

In the aircraft industry, S A E X-4340 steel, heat-treated to from 415 to 450 Brinell, has been used to advantage for propeller shafts, crankshafts, propeller spiders, under carriage parts and engine mount fittings, all of which are subjected to high stresses in service.

Industrial gear manufacturers have developed a successful commercial practice for machining gears of S A E 4340 steel at hardnesses as high as 500 Brinell. A gear blank, for example, was machined from bar stock of Ryerson "Nikrome M" nickel-chromium-molybdenum steel, heat-treated to 477 Brinell. Turning, in this instance, was accomplished in an ordinary lathe, using a standard 5/8-inch square high-speed steel tool, with a 3/16-inch depth of cut, a 1/32-inch feed, and a speed of 18 surface feet per minute.

Machine tool gears benefit by this increased hardness, because they must be wear-resistant to maintain the accuracy and smooth running characteristics required over a long period of service. If advantage is taken of the higher strength accompanying the increased hardness, gears may be redesigned to save appreciable weight.

In a recent demonstration at the laboratory of the International Nickel Co., S A E X-4340 steel, heat-treated to 450 Brinell, was machined on a standard Warner & Swasey turret lathe, using high-speed steel cutting tools of the 18-4-1 type. A cutting oil containing an appreciable percentage of saponifiable oil and sulphur was employed. The machining operations were planned to cover a wide variety of cutting conditions, and included chamfering, turning, drilling, and forming. The turning cut, in which the bar was reduced in diameter from 2 inches to 1 1/2 inches, was taken at a speed of 49 feet per minute, with a feed of 0.0075 inch.

In addition to satisfactory machinability, S A E X-4340 steel possesses high mechanical properties. Its chemical composition is: Carbon 0.35 to 0.45 per cent; manganese 0.50 to 0.80 per cent; nickel 1.50 to 2 per cent; chromium 0.60 to 0.90 per cent; and molybdenum 0.20 to 0.30 per cent. The mechanical properties, when oil-quenched and tempered to a hardness of 477 Brinell, are: Tensile strength 230,000 pounds per square inch; yield point, 210,000 pounds per square inch; reduction in area, 47 per cent; elongation, 12 per cent in 2 inches; and Izod impact, 17 foot-pounds.

Press Brakes in Mass Production in an English Plant

The use of a press brake for several simultaneous operations is an important factor in the production of one hundred tons of finished office filing cabinets, office desks, waste paper baskets, and other metal office furniture and appliances each week by the Art Metal Construction Co. at its Buckingham Palace Works, London, England.

The main blanking and forming section of the plant includes sixteen large power presses and four Cincinnati all-steel press brakes. The first press operation is notching and piercing, which consists mainly of taking out the four corners of the rectangular sheets, piercing holes, and forming small lugs where necessary. The metal sheets then pass on to the forming section, where three progressive operations are performed on press brakes.

One of the most interesting of these jobs is a forming operation on the top of a metal filing cabinet. Three bends are required on each edge of this top panel. The first bend is formed on all four edges by the operator at the left-hand side of the press brake seen in Fig. 1, the second bend by the operator at the center of the machine, and the final bend by the operator at the right-hand of the machine. The operator that produces the final bend also controls the machine.

The first operator draws blanks from a pile beside him, performs his operation, and passes the piece to the second operator, who performs his operation and passes it to the third operator. After the latter has completed his operation, he places the finished top panel in a stack at his end of the machine. Production on each press brake is one finished top panel a minute.

The other sections of the cabinet are also produced by progressive forming on press brakes. The assembly is fast and simple, because the parts come from the machine ready for assembly without fitting.

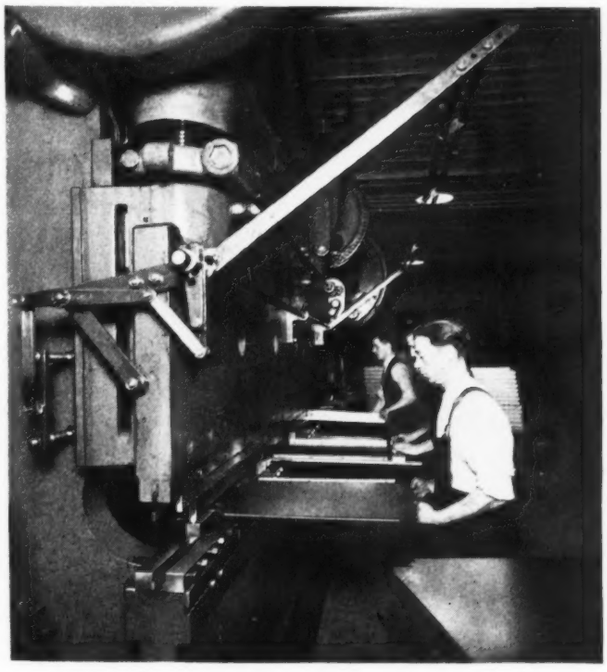


Fig. 1. This Cincinnati All-steel Press Brake on which Progressive Bending Operations are Performed Speeds up the Production of Metal Office Cabinets and Other Furniture in an English Plant

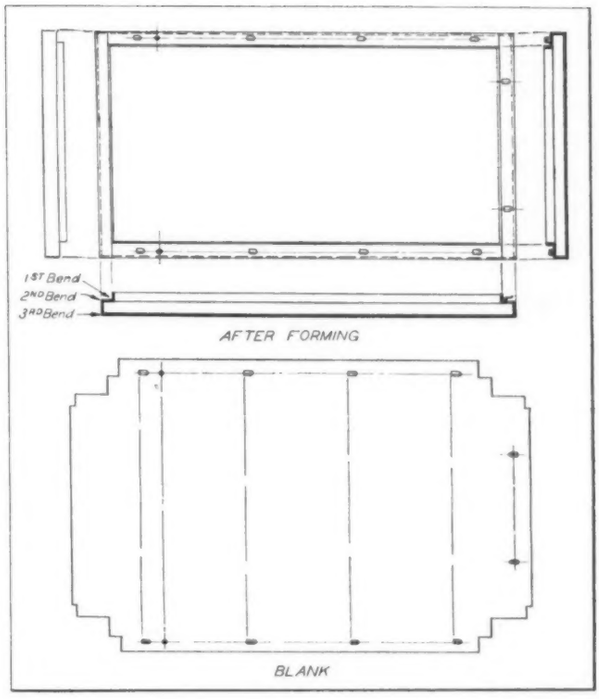


Fig. 2. Diagrams Showing Cut and Punched Metal Sheet and Three Bending Operations that are Performed on it Progressively by Three Operators on the Same Press Brake

* * *

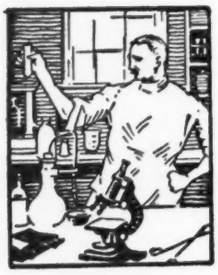
Taxation and Unemployment

According to a study made by the American Society of Tool Engineers, one cause of unemployment is traced to the higher cost of consumer goods occasioned by increased taxation. A study covering 163 business corporations employing 3,000,000 people showed that an average of $576 is paid annually in taxes for every one employed. This enormous tax burden must, of course, be added to the cost of the products, and thus reduces the purchasing power of the employe.

* * *

The American Gear Manufacturers Association, 602 Shields Bldg., Wilkinsburg, Pa., reports that gear sales for July were 9.3 per cent above June of this year and 58 per cent above July, 1939.

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Newly Developed Durez Arc-Resistant Phenolic Molding Compound

An arc-resistant phenolic molding compound known as Durez 8685 has been brought out by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y. The new material was developed specifically to prevent "tracking," in cases where there is combined electrical spark and rubbing action. It has very high resistance to carbonization under an arc. Its electrical properties are materially increased by baking after molding. It holds its high dielectric strength when used at moderately high temperatures. Durez 8685 is somewhat more flexible in its final set than standard materials, and does not crack under the expansion and contraction of metal inserts, around which it can be easily molded. 201

Non-Magnetic, Free-Machining Steel for the Electrical Industry

A free-machining alloy steel having low magnetic permeability, together with valuable mechanical properties, has been developed especially for the electrical industry by the Jessop Steel Co., 605 Green St., Washington, Pa. This steel has a magnetic permeability of from 1.003 to 1.006 at 1000 oersteds magnetizing force at temperatures from sub-zero to boiling. The illustration shows a piece of electrically magnetized iron at the right, and a piece of the new non-magnetic steel at the left; it will be noted that all the iron filings adhere to the iron sample at the right.

This steel, in the annealed condition, has a tensile strength of from 80,000 to 110,000 pounds per square inch; a yield point of from 35,000 to 60,000 pounds per square inch; an elongation in 2 inches of from 25 to 50 per cent; a reduction in area of from 30 to 60 per cent; and an Izod impact value at room temperature of 80 foot-pounds. The steel can be readily formed, welded, machined, and blanked. It can be used in transformer, controller, and switch covers; entrance plates; spacing bars; end fingers; and numerous other parts of electrical equipment. 202

The Non-magnetic Steel at Left Shows No Attraction for the Iron Filings that Adhere to the Magnetized Iron at Right

Bermax—A High-Lead Babbitt with Improved Properties

An improved lead-base bearing alloy that has been demonstrated to be suitable for a wide range of applications in the automotive and other industries by a number of exhaustive tests has been introduced by the Federal-Mogul Laboratories of Detroit, Mich., under the name of Bermax. This alloy has a melting point slightly higher than that of the tin-base bearing alloys, and can be cast without fear of segregation. It has the advantage of not being subject to oil corrosion.

The alloy contains 82 to 86 per cent lead, 9 to 11 per cent antimony, 5 to 7 per cent tin, and a maximum of 0.25 per cent copper. It has a maximum permissible unit pressure of 1800 pounds per square inch, and a maximum oil reservoir temperature of 225 degrees F. It is particularly recommended for rebabbitting steel-back or bronze-back bearings or housings of cast steel or cast bronze, into which the babbitt is poured or cast direct. The surfaces to be babbitted are ordinarily tinned or soldered prior to pouring, in order to obtain an effective bond. Under these conditions its use is recommended for all installations where any tin-base or lead-base babbitt is now being utilized, such as in Diesel engines, pumps, and compressors. Where trouble with a tin-base alloy is experienced due to insufficient load capacity and premature fatigue, and where

To obtain additional information about materials described on this page, see lower part of page 154.

the lack of crankshaft hardness prevents the use of cadmium-silver or copper-lead bearings, this high-lead alloy has proved to be quite satisfactory. 203

Nickel-Silver Alloys Found Useful in Stainless Steel

Metallurgically, the most important features in the improvement of stainless steels have been the expanding use of alloying elements, such as molybdenum and columbium, and the addition of new types, such as the "leaded stainless" type, to the already successful free-machining stainless steels. Attention has recently been directed to the improvement of stainless steel by the addition of small quantities of silver, which is generally in the form of an alloy of 95 per cent nickel and 5 per cent silver. 204

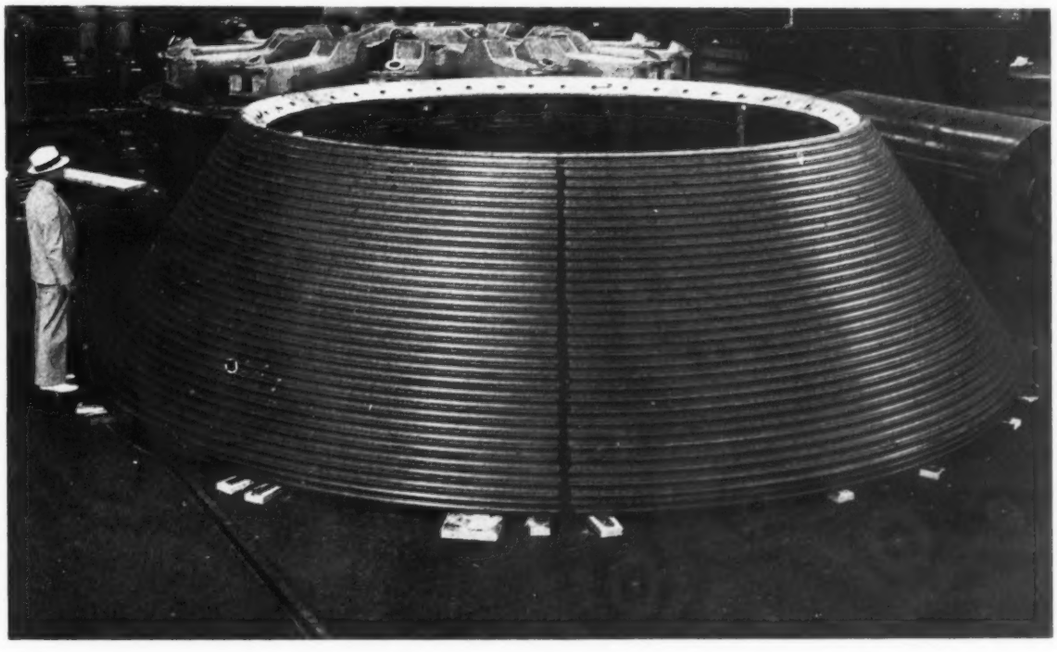
Magnetic Alloy that Can be Drawn and Rolled

A new magnetic alloy composed of cobalt, vanadium, and iron, called "Vicalloy," that can be made to hold more permanent magnetism than any commercial material heretofore developed, has recently been announced by the Bell Telephone Laboratories, New York City. In addition, this alloy can be drawn and rolled—a property of decided advantage in many applications which is not possessed by other permanent magnet materials. Several thousand feet of tape 1/500 inch thick and 1/20 inch wide rolled from this material have been produced for sound-recording purposes.

The new material is composed of 6 to 16 per cent vanadium, 30 to 52 per cent iron, and 36 to 62 per cent cobalt. From the molten state it is cast into an ingot, which is hot-swaged to 1/4 inch diameter. It is then drawn into wire or rolled into tape, as desired. In its final form, it is heat-treated to develop its magnetic qualities. 205

New Light-Weight, Rustproof Alloy of High Strength

A rustproof alloy that is 66 per cent lighter than steel or iron and has good forming and drawing qualities has been introduced under the designation of No. 301 alloy by the Colonial Alloys Co. of Philadelphia, Pa. This alloy lends itself to gas welding, spot welding, seam welding, arc welding, brazing, soldering, chemical fusion welding, and reaction soldering. It has good thermal and electrical conductivity properties, is non-magnetic, and polishes to a lustrous, chrome-like appearance. The physical properties are as follows: Ultimate tensile strength, 72,000 pounds per square inch; elongation in 2 inches, 32 per cent; yield point, 57,530 pounds per square inch; hardness, 109 Brinell. It is available in sheet, plate, rod, bar, wire, pipe, tubing, and extruded forms in a wide range of gages and sizes.....206



Part of a Mammoth Mine Hoist Drum Made from Nickel-molybdenum Cast Iron Having a Tensile Strength of from 55,000 to 60,000 Pounds per Square Inch and a Brinell Hardness of 255. The Grooves, Machined Exceedingly Smooth to Minimize Rope Wear, Take a 1 7/8-inch Wire Rope

To obtain additional information about materials described on this page, see lower part of page 154.

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Check on Form at Bottom of Page 153 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the September Number of MACHINERY

Grinding Equipment

CINCINNATI MILLING MACHINE AND CINCINNATI GRINDERS INCORPORATED, Cincinnati, Ohio. Booklet entitled "Better Grinding in Your Tool-Room," suggesting results possible by the use of modern grinding equipment. Also folder entitled "The Use of Abrasives for Removing and Finishing Metals." 1

Lighting Equipment

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Leaflet descriptive of the FPR twin-lamp fluorescent luminaire, designed especially for illuminating low-bay industrial areas. Booklet A-3618, entitled "Fluorescent Lighting—a Practical Guide to the Application of Mazda F Lamps and Equipment." 2

Materials-Handling Equipment

CLEVELAND TRAMRAIL DIVISION, CLEVELAND CRANE & ENGINEERING CO., Wickliffe, Ohio. Bulletin 2004-A, entitled "How to Determine Where Overhead Materials-Handling Equipment Can be Used Profitably," including the preparation of a lay-out for a materials-handling system. 3

Cold-Finished Steel Bars

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill. Bulletin entitled "Cold-Finished Bars," describing the wide range of such steel bars carried in stock for immediate shipment. Chemical analysis, working properties and suggested applications are included. 4

Electric Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletin GEL-619, entitled "Many Companies are Getting 57 to 120 Per Cent Annual Return from One Kind of Investment—How About You?," describing the savings effected in power bills with G-E pyranol capacitors. 5

Milling Machines

KEARNEY & TRECKER CORPORATION, Milwaukee, Wis. Bulletin entitled "Climaxing 42 Years of Building Milwaukee Milling Machines—1898-1940," giving the important events in the company's history and briefly illustrating and describing the plant 6

Turret Lathes

GISHOLT MACHINE CO., 1209 E. Washington Ave., Madison, Wis. Gisholt Performance Data Sheets Nos. 50-53, inclusive, covering results obtained in the machining of small tools, steel castings, bronze bushings, and helical gear blanks. 7

Welded Stainless Tubing

CARPENTER STEEL CO., WELDED ALLOY TUBE DIVISION, Kenilworth, N. J. Data book covering welded stainless tubing—what it is and where it is used—together with complete design and working instructions. 8

Self-Lubricating Bearings

JOHNSON BRONZE CO., 520 S. Mill St., New Castle, Pa. Loose-leaf catalogue sheets containing data designed to answer questions asked by engineers and designers concerning Ledaloyl self-lubricating bearings. 9

Hydraulic Riveting and Pressing Equipment

HANNIFIN MFG. CO., 621-631 S. Kolmar Ave., Chicago, Ill. Bulletin 53, on "Hy-power" hydraulic riveting, punching, and pressing equipment, including multiple piercing and riveting units. 10

Cast Ferrous Metal

LINK-BELT CO., 307 N. Michigan Ave., Chicago, Ill. Booklet 1750, describing the physical properties and applications of Promal, a cast ferrous metal having high strength and a marked ability to resist abrasive wear. 11

Grinding Wheels for Carbide Tools

NORTON CO., Worcester, Mass. Booklet 388, entitled "Norton Metal-Bonded Diamond Wheels"—a handbook on the reconditioning and sharpening of single-point cemented-carbide tools. 12

Castings

MEEHANITE RESEARCH INSTITUTE OF AMERICA, INC., 311 Ross St., Pittsburgh, Pa. Bulletin 9, entitled "Meehanite, the Metal for Machine Tool Castings," outlining the engineering properties and describing specific applications. 13

Grinding Wheels

MANHATTAN RUBBER MFG. DIVISION OF RAYBESTOS-MANHATTAN, INC., 34 Townsend St., Passaic, N. J. Bulletin describing vibration dampener bushings, a resilient mounting used for Manhattan wheels for portable grinders. 14

Turret Lathes

JONES & LAMSON MACHINE CO., Springfield, Vt. Catalogue loose leaves Nos. 4 and 5, on ram type universal turret lathes; Nos. 7D, 8A, 8B, and 8D, on saddle type universal turret lathes. 15

Bronze Bearings, Bars, and Strip Stock

BOSTON GEAR WORKS, INC., North Quincy, Mass. Catalogue on Oilite bronze bearings and Oilite cored and solid bars, plate and strip stock carried in stock. 16

Metal-Spraying Equipment

METALLIZING ENGINEERING CO., INC., 21-07 Forty-first Ave., Long Island City, N. Y. First number of *Metco News*, a periodical devoted to the latest developments in, and applications of, metal spraying. 17

Stamping-Die Metal

MORRIS P. KIRK & SON, INC., 2717 S. Indiana St., Los Angeles, Calif. 27-page book on Kirksite "A," a ma-

terial used for stamping dies when a comparatively small number of stampings are required. 18

Drilling, Boring, and Reaming Machines

BARNES DRILL CO., 814 Chestnut St., Rockford, Ill. Bulletin 134-D, describing "Hydram" self-oiling hydraulic drilling, boring, and reaming machines. 19

Lathes and Milling Machines

HARDINGE BROTHERS, INC., Elmira, N. Y. Bulletin entitled "Fifty Years of Precision," illustrating and describing precision tool-room lathes, milling machines, bench lathes, and second-operation machines. 20

Formulas and Tables of Gear-Tooth Parts

PHILADELPHIA GEAR WORKS, Erie Ave. and G St., Philadelphia, Pa. Pocket chart giving complete formulas, rules, and tables of spur gear tooth parts and dimensions. 21

Stainless Steel

REPUBLIC STEEL CORPORATION, Cleveland, Ohio. Folder giving analyses and properties of thirteen types of Enduro stainless steel. Also booklet entitled: "The Welding of Republic Enduro Stainless Steel." 22

Metal-Cutting Machines

CONTINENTAL MACHINES, INC., 1312 S. Washington Ave., Minneapolis, Minn. Circular entitled "Eight Different Jobs Show Doall Advantages over Eight Basic Cutting Methods." 23

Carbide Tool Grinders

EX-CELL-O CORPORATION, 1212 Oakman Blvd., Detroit, Mich. Bulletin 46101, on Ex-Cell-O carbide tool grinders, and their use. 24

Prevention of Adhesion of Weld Spatter

GENERAL ELECTRIC CO., Schenectady, N. Y. Leaflet 3198A, on Glyptal No. 1294 for the prevention of adhesion of weld spatter. 25

Wheel-Balancing Stand

CINCINNATI GRINDERS INCORPORATED, Cincinnati, Ohio. Circular G-454, on Cincinnati grinding-wheel balancing stand and arbors. 26

Press Brakes

VERSON ALLSTEEL PRESS CO., 9300 S. Kenwood Ave., Chicago, Ill. Bulletin JPB40, covering Junior press brakes for forming, bending, coping, notching, and multiple punching. 27

Tool Steel

JESSOP STEEL CO., 605 Green St., Washington, Pa. Chart giving the brands of Jessop tool steels recommended for different kinds of tools, dies, and other applications. 28

Welding Positioners

CULLEN-FRIESTEDT CO., 1300 S. Kilbourn Ave., Chicago, Ill. Bulletin WP-19, describing welding positioners for making welds economically, quickly, safely, and easily. 29

Geared Drives

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Booklet 3650, describing the Westinghouse complete line of Type SU speed increasers. 30

Automatics

CONE AUTOMATIC MACHINE CO., INC., Windsor, Vt. Circular entitled "Six Ways to Step up Production," showing six different types of automatic machines. 31

Cold-Rolled and Cold-Drawn Steel

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York City. Folder on cold-rolled and cold-drawn specialty steels. 32

Electric Equipment

TRICO FUSE MFG. CO., 2948 N. 5th St., Milwaukee, Wis. Folder entitled "Worth Their Weight in Gold," on Kliplok clamps for fuse clips. 33

Baking and Drying Lamp Units

FOSTORIA PRESSED STEEL CORPORATION, Fostoria, Ohio. Leaflet on portable infra-red industrial baking and drying units. 34

Accident Prevention

SELLSTROM MFG. CO., 615-649 N. Aberdeen St., Chicago, Ill. Catalogue

---

To Obtain Copies of New Trade Literature

listed on pages 152-154 (without charge or obligation), mark with X in the squares below, the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	

Name ..... *Position or Title* .....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm .....

Business Address .....

City ..... *State* .....

[SEE OTHER SIDE]

18, on industrial safety goggles and other eye protection equipment. 35

Cutting Tools

McKENNA METALS Co., 147 Lloyd Ave., Latrobe, Pa. Folder entitled "Cut Steel Profitably with Kennametal Tools and Blanks." 36

Hydraulic Pumps and Valves

RACINE TOOL & MACHINE Co., Racine, Wis. Catalogue P-10A, on variable-volume hydraulic pumps and hydraulic valves. 37

Lubrication Equipment

FARVAL CORPORATION, 3276 E. 80th St., Cleveland, Ohio. Bulletin 10-A, on Farval "Dualine Jr." centralized system of lubrication. 38

Dust Collectors

AMERICAN FOUNDRY EQUIPMENT Co., Mishawaka, Ind. Circular 52, on wet disposal unit for dry type dust collectors. 39

Oil-Retaining Bearings

BOUND BROOK OIL-LESS BEARING Co., Bound Brook, N. J. Stock List No. 1, covering "Compo" oil-retaining porous bronze bearings. 40

Industrial Diamonds

ANTON SMIT & Co., INC., 24 State St., New York City. Folder on diamonds for industrial purposes. 41

Materials-Handling Equipment

ALL STEEL WELDED TRUCK CORPORATION, Rockford, Ill. Loose-leaf catalogue sections covering lift jacks, trucks, and platforms. 42

Materials for Electrical Industry

ALLEGHENY LUDLUM STEEL CORPORATION, Pittsburgh, Pa. Blue Sheet B-202, on Allegheny Ludlum products for the electrical industry. 43

Milling Machines

MIDWAY MACHINE Co., 2324 University Ave., St. Paul, Minn. Folder covering "Millmaster" vertical milling machines. 44

Electric Traveling Cranes

NORTHERN ENGINEERING WORKS, 210 Chene St., Detroit, Mich. Bulletin S-107, on electric traveling cranes for heavy-duty service. 45

Metal-Cutting Machines

PEERLESS MACHINE Co., Racine, Wis. Catalogue 51, illustrating and describing the full line of Peerless universal metal-cutting saws. 46

Pyrometers

J-B-T INSTRUMENTS, INC., 441 Chapel St., New Haven, Conn. Bulletin entitled "New Portable Potentiometer-Pyrometer." 47

Conveyor Belts

B. F. GOODRICH Co., Akron, Ohio. Publication entitled "Cost-Finding Record Book for Conveyor Belts." 48

Speed Reducers

D. O. JAMES MFG Co., 1120 W. Monroe St., Chicago, Ill. Catalogue 17-A, giving complete data on motorized speed reducers. 49

Torque Indicators

BLACKHAWK MFG. Co., 5325 W. Rogers St., Milwaukee, Wis. Catalogue 40-T, describing torque indicators for capacities up to 1000 foot-pounds. 50

V-Belts

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J. "Master Manual," containing 72 pages, on the transmission of power by V-belts. 51

Lubrication Equipment

ONSRUD MACHINE WORKS, INC., 3900 Palmer St., Chicago, Ill. Bulletin on controlled centrifugal force-feed lubrication. 52

Turbo-Blowers

ALLIS-CHALMERS MFG. Co., Milwaukee, Wis. Bulletin B-6048, illustrating and describing single-stage turbo-blowers for pressures of from 1 to 6.25 pounds. 53

Corrosion-Resistant Alloy

BURGESS-PARR Co., Freeport, Ill. Bulletin 104, on "Illium," a corrosion-resistant alloy with many industrial applications. 54

Soldering Machines

ELECTRIC SOLDERING IRON Co., INC., Deep River, Conn. Catalogue sheet No. 510 on "Esico" soldering machines. 55

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 155-170 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the squares below, the identifying number found at the end of each description on pages 155-170—or write directly to the manufacturer, mentioning machine as described in September MACHINERY.

61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 150-151, mark with X in the squares below, the identifying number found at end of each description on pages 150-151—or write directly to the manufacturer, mentioning name of material as described in September MACHINERY.

201	202	203	204	205	206

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Lees-Bradner Thread Milling Machine for Heavy Work

The Lees-Bradner Co., Cleveland, Ohio, has brought out a Model CT chucking type heavy thread milling machine which has a 13-inch hole through the work-spindle and a swing over the ways of 24 inches. This machine is designed primarily for the generation of threads by means of the ring type or hobbing process, using either shank or shell type cutters that require only one and a fraction of a revolution to complete an entire threaded portion. It is adapted for the precision threading of propeller blades, propeller hubs, breech-blocks, gun barrels, other munitions, landing-gear components, and similar parts of considerable size.

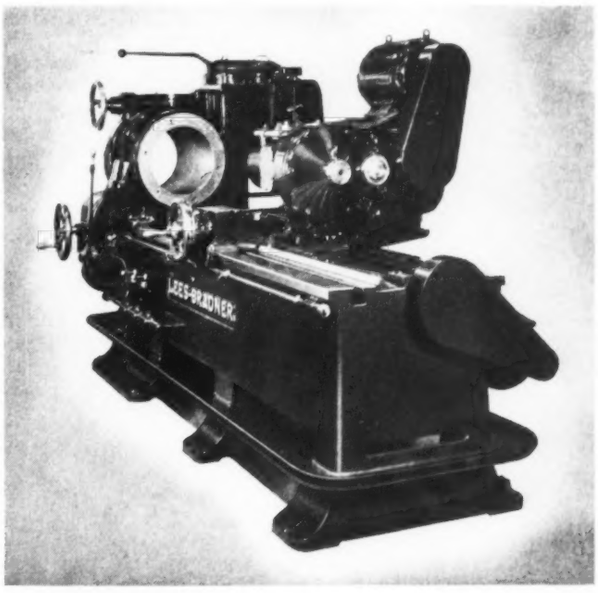
This thread miller is driven by two main motors, the cutter-driving motor being mounted directly on the cutter-head, while the work-head motor is mounted partly within the base of the machine. A separate motor-driven coolant pump supplies an adequate amount of coolant, irrespective of the operation performed.

The machine is push-button controlled and the two main driving motors are electrically interlocked, so that the headstock motor cannot be operated unless the cutter is rotated. This feature prevents damage to the work or the cutter through improper operation. Traverse of the cutter-head along the bed of the machine is controlled by limit switches, operated by easily adjusted stops on the front of machine. Control of the direction of rotation of either of the main driving motors is obtained by reversing drum switches. The drive from the motors is through V-belts, a simple take-up being provided for adjusting slack in the belts on both drives, which are completely enclosed. The headstock, which is of very rugged construction, has been carefully designed to facilitate making occasional necessary adjustments. All shafts within the headstock are short, designed for strength, and equipped throughout with anti-friction bearings.

The work-spindle is arranged for the installation of various types of work-holding fixtures, such as collets, three- or four-jaw chucks, or special work-holding fixtures. The work-spindle itself rotates in large hand-scraped, hard bronze bearings. A full set of lead and feed gears for producing the various leads and feeds within the range of the machine is supplied as part of the regular equipment. The lead gears and the feed gears are independent of each other, and either can be changed without affecting the other. Since many of the threads produced must be registered angularly and axially, provision is made for adjusting the work-spindle and cutter carriage independently of each other through the use of handwheels mounted on the headstock.

Extreme rigidity of the cutter-head is one of the outstanding features of this machine. The cutter-spindle has a No. 12 B&S taper, and is drilled to accommodate a draw-rod. A two-speed gear-box with pick-off gears gives a total of eighteen cutter speeds. Three methods of traversing the cutter-head toward or away from the nose of the work-spindle are available. The depth of the cut can be accurately adjusted by means of a precision micrometer screw and a large graduated micrometer dial reading in thousandths of an inch. Once the proper depth is obtained, a simple, positive mechanical stop is employed which automatically maintains the exact depth of cut and assures work of uniform size. An extra swiveling cutter-head and a tailstock can be supplied for work that is to be done on centers. Work held on centers can be threaded with either a ring or a disk cutter.

The machine is made in several bed lengths. The maximum distance between the work-spindle and the cutter-spindle is 24 inches on the machine with the shortest bed, and 102 inches with the longest bed. 61



Chucking Type Thread Milling Machine Built by the Lees-Bradner Co., for Munitions and Similar Work

To obtain additional information on equipment described on this page, see lower part of page 154.

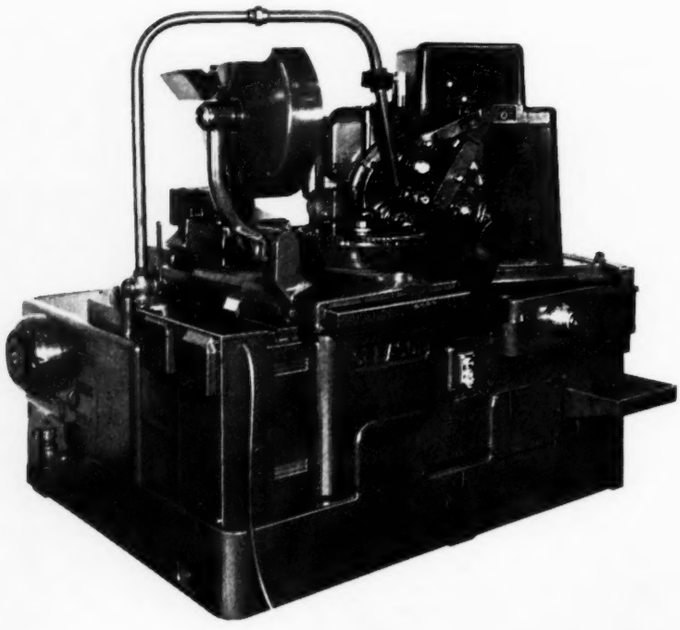


Fig. 1. "Revacycle" Bevel Gear Cutting Machine

Gleason "Revacycle" for Cutting Bevel Gears

The Gleason Works, 1000 University Ave., Rochester, N. Y., has just brought out a high-production machine known as the "Revacycle," which is designed for cutting straight bevel gears, such as those used in automotive differentials, washing machines, and textile machinery. This machine is of entirely new design, and has been developed to provide the fastest practical means for cutting straight bevel gears. The gear teeth are roughed and finished in one operation with a single-disk cutter of special design. While normally arranged for the continuous production of one particular gear or pinion, the Revacycle can also be arranged to handle several jobs consecutively.

The Revacycle cutter has a number of radially arranged roughing blades, followed by a number of similarly arranged finishing blades with a gap between the two sets of blades, as shown in Fig. 2. The cutter is mounted on a reciprocating slide, and as it rotates in engagement with the gear blank, it moves along the lengthwise direction of the tooth space. As the cutter moves from the small to the large end of the blank, the roughing blades rough out a tooth space, which is finished by the finishing blades on the back stroke.

The blank is held stationary during the cutting operation, and at the end of each return stroke of the cutter, it is indexed at the gap position. Each revolution of the cutter completes a tooth space, the tooth form being determined by the cutter motions and the blade profiles.

Except for chucking, operation of the machine is entirely automatic. There are no chucking delays, however, since the machine is provided with a rotary work-holding turret with three spindles. Thus, gears are removed and blanks loaded at two stations. When a gear is completed, the turret indexes automatically to bring the next blank to the cutting station. A hydraulic unit supplies power for clamping the turret, for chucking the blank, and for operating the chip remover.

The machine has a capacity for cutting gears having a maximum cone distance of 3 inches; maximum face width, 1 1/2 inches; pitch limited by a maximum hole depth of 0.450 inch; ratios, from 1 to 1 up to 2 to 1; pitch diameters, from 2 3/4 to 5 1/2 inches; and number of teeth, 8 to 40. The floor space occupied is 65 by 85 inches. 62

Hanchett Vertical-Spindle Disk Grinder

The Hanchett Mfg. Co., Big Rapids, Mich., has brought out a new vertical-spindle disk grinder designated the No. 153. The abrasive grinding disk of this machine is 53 inches in diameter by 1 inch

Fig. 2. Close-up View of "Revacycle" Cutter

Hanchett Vertical-spindle Grinder with 53-inch Disk

To obtain additional information on equipment described on this page, see lower part of page 154.

thick, and is made up in eight sections. The sections are attached to a 53-inch steel plate by means of fillister-head screws that pass down through openings in the abrasive, which is vulcanized to thin steel plates. The steel disk, in turn, is attached to a wheel flange 34 inches in diameter by 4 inches thick.

The wheel-spindle is driven by V-belts at a speed of 435 R.P.M. by a 25-H.P. vertical motor located within the machine base. An oscillating type wheel dresser built into the machine permits passing the dressing wheel from the outside of the disk to the center to maintain a true grinding surface. The dresser arm is swung entirely clear from the machine while work is being ground. Openings beneath the grinding disk are provided for connection with the dust exhaust system. The grinder can also be arranged for wet grinding. The weight is 7500 pounds. 63

General Electric Geared Type Limit Switch

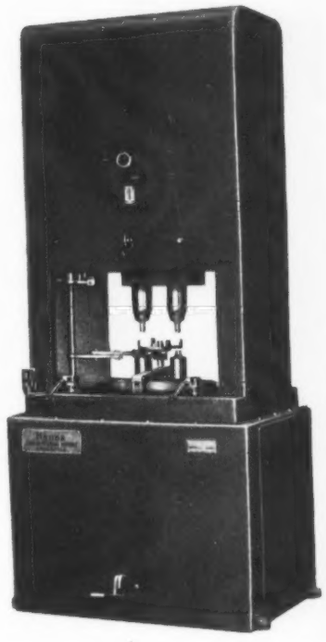
A new small-sized, geared-type, limit switch has been placed on the market by the General Electric Co., Schenectady, N. Y., for application on motor-driven devices where it is necessary to limit the rotation of the motor shaft or some rotating member or gear on the driven machine. This switch is small in size, being only 4 11/16 by 3 1/2 by 1 29/32 inches.

The mechanism can be easily adjusted to operate contacts between a minimum of one-half turn of the driving shaft to a maximum of 120 turns. An over-travel of 3 1/2 turns is provided to prevent accidental damage to the mechanism. 64

Hanna Electric-Hydraulic Riveting Press

From one to six, or more, rivets can be driven simultaneously on an electric-hydraulic riveting press recently added to the line of the Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill. With this new machine, the same amount of pressure is exerted on each rivet, regardless of variations in the length or hardness of the rivet, or in the thickness of the material. Work assembling, loading, aligning, clamping, and rivet-nesting features can be incorporated in the machine, as shown in the illustration. The tonnage-adjustment control and gage, and the oil-level sight glass are located at eye level. A complete riveting stroke for all dies requires less than two seconds.

The motor, pump controls, piping, cylinder, and reservoir are totally enclosed, permitting the motor to be of the open-frame type. Front and rear panels can be removed in less than a minute to make the equipment accessible. A side panel affords access to the controls. The entire machine can be lifted out of its base without disturbing the hydraulic, electrical, or mechanical elements. This machine is available in capacities ranging from 10 to 100 tons. 65



Hanna Riveting Press with Capacity for Driving Six Rivets Simultaneously

New Broaching Equipment Built by American Broach & Machine Co.

To meet the requirements of one of its customers, the American Broach & Machine Co., Ann Arbor, Mich., recently built the special four-station hydraulic broaching machine shown in Fig. 1. This machine is equipped for finish-broaching the half-round slots in differential cases, such as the one shown on the shelf at the left in Fig. 2. It is arranged to accommodate differential cases of several sizes, and each broaching station is equipped with two fixtures.

The half-round surfaces in the half-sections of the differential cases are finish-broached in permanent set-ups in two fixture stations like

Fig. 1. Four-station Hydraulic Broaching Machine

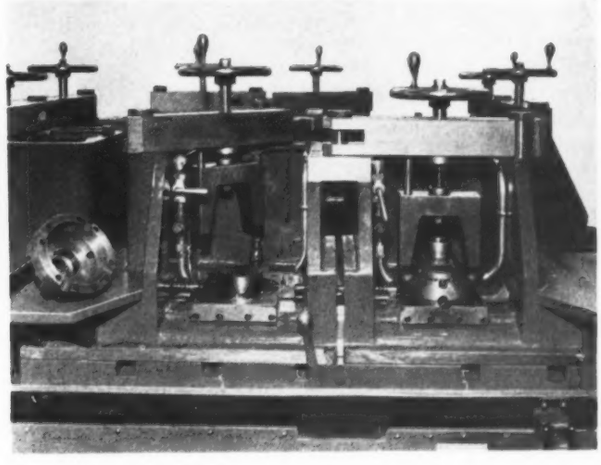


Fig. 2. One of Four Stations of Machine Shown in Fig. 1

To obtain additional information on equipment described on this page, see lower part of page 154.

the one shown in Fig. 2, one station being located on each side of the machine. Any one of four differential-case halves that make up two separate differential-case assemblies can be finished without changing the tool equipment. The design permits any side of the machine to be operated independently of the others. Two adjacent or opposite sides can be kept in production simultaneously by employing two operators, one for each side. A separate machine control is provided for each cylinder-slide assembly.

The fixtures, as shown in Fig. 2, are designed to locate the work from the joint counterbore or shoulder. One-half of the assembly is completed on two fixtures on one side of the machine as shown. A manually operated screw clamp of the swing-out type is provided for holding the work. The fixture plates can be adjusted laterally to facilitate setting up the tools. The material broached is malleable iron, 0.010 inch of stock being removed on the radius. The production is 90 pieces per hour for each side of the machine.

The machine has a normal capacity of 4 tons for each cylinder. The broaching speed is 18 feet per minute, and the return speed 28 feet per minute. The cylinder stroke is 18 inches, the work height 40 inches, and the over-all height 50 inches. The net weight of the machine is 10,000 pounds, and the operating space required, 14 by 14 feet.

In Fig. 3 is shown a set-up on an American improved three-way broaching machine designated T-24. This machine is adapted for push-broaching, pull-broaching, and surface broaching. The outstanding improvement in this machine is the hydraulically operated and timed retrieving mechanism, which leaves both hands of the operator free for manipulation of the machine. This machine is built in several capacities, including 4-, 6-, and 8-ton sizes, with a 24-inch stroke. 66

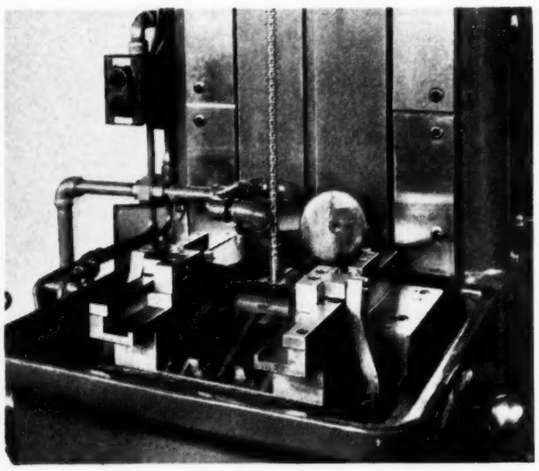
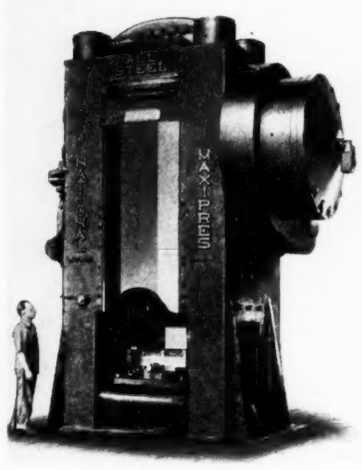


Fig. 3. American Three-way Broaching Machine with Hydraulic Broach Retrieving Mechanism

National High-Speed Forging Press

The National Machinery Co., Tiffin, Ohio, is introducing to the trade a line of high-speed forging Maxipresses suitable for a great variety of forging work. The drive for this new line of presses has been especially designed to meet the requirements for higher speeds. The No. 6 Maxipres, shown in the illustration, operates at a speed of 80 strokes per minute and corresponds in capacity with a 5000-pound steam hammer or a 6500-pound board drop-hammer. This high operating speed has been obtained by transferring the driving clutch from the back-gear shaft directly to the crankshaft; with this arrangement, there is less dead weight to start and stop and a lower power consumption. An air cylinder, working on the up stroke, assists in the stopping action and provides air for operating the clutch. The high operating speed of this press makes possible a large reduction in the contact time between the dies and the hot stock, produces a better flow of metal, and materially improves the life of the die.

These high-speed forging Maxipresses are built in sizes ranging from No. 1 1/2 to 6, with corresponding capacities from 800 to 6500 pounds. The operating speeds range from 130 strokes per minute on the smallest size machine down to 80 strokes per minute on the largest size. The largest, or No. 6, Maxipres weighs 300,000 pounds. 67



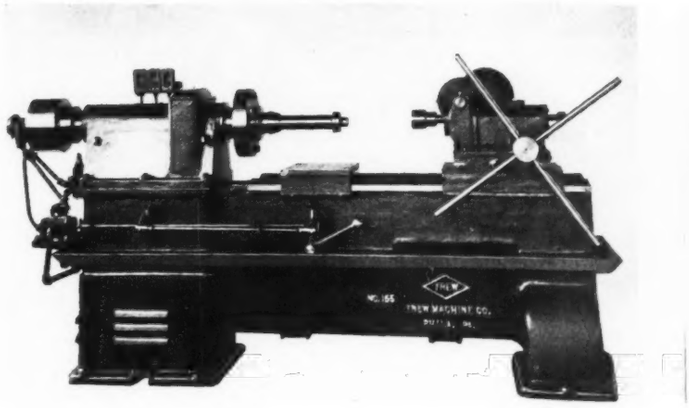
High-speed Forging Press Built by the National Machinery Co.

Frew Shell-Centering Machine

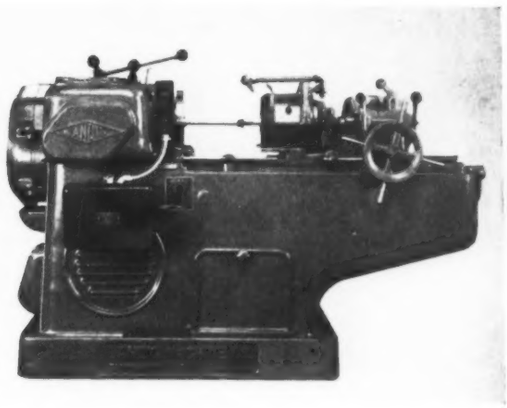
A shell-centering machine consisting of a bed having at one end a headstock that carries the main spindle, and at the opposite end a motor-driven unit that operates the centering drill, has been brought out by the Frew Machine Co., 132 W. Venango St., Philadelphia, Pa. The main spindle of this machine runs in Timken tapered roller bearings, and is provided with a faceplate to which the shell-holding arbor is attached. Various types of arbors are used for holding the shells, the one most commonly used being provided with three expanding plugs at the front end and three similar plugs at the rear end, which, when expanded by the hydraulic cylinder mounted on the rear end of the spindle, center the shell and grip it firmly. The spindle is driven from a motor in the base by means of V-belts and a silent chain.

The main spindle head is mounted in a chip pan, which, in turn, is held on a cabinet base that has a reservoir for the coolant. The drilling unit consists of a driving motor geared to the drill spindle. The drill spindle is carried in a quill and is fed through the quill for drilling the center in the shell. The feed is by means of a capstan wheel which operates through a rack and pinion and is provided with stops for regulating the depth. The whole drilling unit is mounted on a slide fitted to a sub-base on the bed. The slide can be moved at right angles to the center line of the bed by means of a hydraulic cylinder, so that the drilling unit can be moved to the rear of the machine to facilitate loading and unloading.

To obtain additional information on equipment described on this page, see lower part of page 154.



Shell-centering Machine Brought out by the Frew Machine Co.



Landmaco Special Threading Machine Built by Landis Machine Co., Inc.

A 2-H.P. motor drives the main spindle, and a 1-H.P. motor drives the drill spindle. A motor-driven hydraulic power unit is also furnished. The three motors are controlled by means of push-button operated magnetic switches. 68

Center-Fired Rotary Furnace

A new type, center-fired, rotary, forging and heat-treating furnace has been developed by the Mahr Mfg. Co., Division of Diamond Iron Works, Inc., 18th Ave. N. and 2nd, Minneapolis, Minn. The single-burner center-firing principle incorporated in the design of this furnace is an outstanding feature. The burner, located at the bottom of the hearth, fires through a long combustion cone of special design, so that the products of combustion become stabilized before they come in contact with the steel, thereby minimizing scale and decarburization.

The center-firing principle eliminates cold spots, even at the furnace door, and the single burner assures close, uniform control over the furnace atmosphere. Positive pressure within the furnace is maintained by an automatic Vent-O-Matic stack damper. The rotary table is operated by a variable-speed drive. A special door with an air curtain protects the operator from the heat.

The furnace can be equipped with full-automatic temperature controls and an individual low-pressure blower. It is heavily insulated throughout, and supported by heavy steel structures. These furnaces are manufactured with hearth diameters ranging from 4 to 9 feet for operation on either oil or gas, fired at temperatures of from 1400 to 2500 degrees F. 69

Landmaco Special Threading Machine

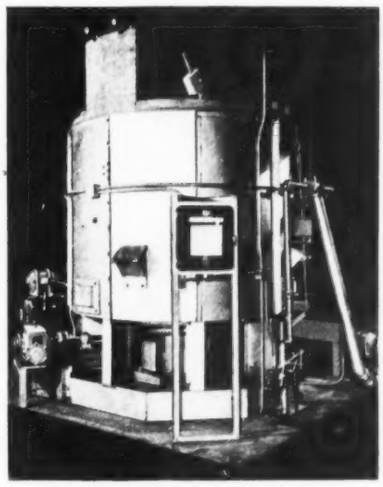
The Landmaco threading machine here illustrated was developed recently by the Landis Machine Co., Inc., Waynesboro, Pa., for handling special threading operations in which extremely close tolerances for concentricity must be maintained between the thread and the body of the work. Since such work is usually ground, the grinding operation being handled by supporting the work between centers, provision is made for supporting the work in a similar manner for threading.

The special mechanical features of this threading machine include a faceplate on the machine spindle which takes the place of the usual die-head, a special carriage front on which the die-head is mounted, and a tailstock which is adjustable and also supports a center. The faceplate, which has a live center, is employed in exactly the same manner as the faceplate on a grinding machine or lathe that employs a dog for driving the work.

The special carriage supports the Lanco die-head, which, in this case, is used as a stationary type head, although it is ordinarily applied to a live spindle. Provision is made for opening and closing the die-head with a yoke when necessary. The adjustable tailstock is clamped in position on ways located on the rear side of the machine bed. These ways are of sufficient length to permit handling work ranging from 2 to 16 inches in length.

The tailstock center is advanced to, or withdrawn from, the work by a quick-acting lever on top of the tailstock housing. The center can be held rigidly in position by means of a clamping lever, also located on top of the tailstock.

This threading machine is of the lead-screw type, the thread being generated by revolving the work between the centers, and the die-head being propelled onto the work, with the thread lead controlled by the lead-screw. Since the work is turned, threaded, and later ground between centers, an unusually high degree of concentricity can be maintained between the thread and the body of the work. 70



Mahr Center-fired Rotary Forging and Heat-treating Furnace

Ingersoll-Rand Light-Weight Compressor

A two-stage, air-cooled compressor for delivering 60 cubic feet per minute at a discharge pressure of 100 pounds per square inch, known as D-60, has been placed on the market by the Ingersoll-Rand Co., Phil-

To obtain additional information on equipment described on this page, see lower part of page 154.

lipsburg, N. J. Compactness and light weight are among the features aimed at in the design of the unit. It will operate most of the pneumatic tool equipment in common use. It is available in three mountings—the "Push-about," mounted on roller-bearing, pneumatic-tired wheels; the "Deluxe," a spring-mounted high-speed trailer unit with tool boxes; and the "Utility," a unit that can be placed on a service truck. 71

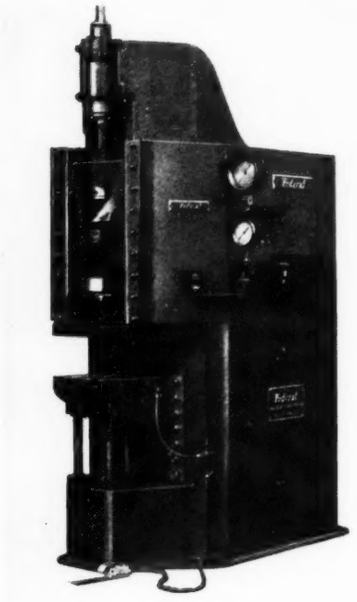
Federal Heavy-Duty Projection Welder

A new heavy-duty projection welder that can be furnished for hydraulic, air, or motor operation, has been added to the line of resistance welding equipment built by the Federal Machine & Welder Co., Warren, Ohio. This new projection welder is known as the P-4 type. The machine illustrated is a direct hydraulically operated welder which has a two-pressure pump capable of giving very high-speed operation with a comparatively small pump-driving motor, due to the fact that low pressure is used for bringing the slide down until the electrodes come in contact with the work. When contact is made by the electrodes, the high pressure is automatically applied for performing the welding operation. Upon the completion of the welding cycle, the head is returned by low pressure.

The hydraulic circuit is designed to permit adjusting both the high and low pressures, so that the proper pressure for a given job can be applied by adjusting the pressure valve. A gage shows the actual pressure being applied to the work on each stroke. An adjustable pressure switch operates the timer, thus allowing a predetermined pressure to be obtained and assuring that the timing circuit will be held off until the required welding pressure is built up.

This machine is offered in five transformer capacities, ranging from 250 to 600 K.V.A. A four-point regulator switch gives a total of eight steps of heat regulation through a high and low four-point tap arrangement. The stroke of the welding slide is adjustable from 1 inch to 4 inches, and the lower combination knee and platen has an 8-inch vertical adjustment through three jack-screws which insure accurate alignment.

Proper cooling facilities are provided in the secondaries, platens, and electrodes. Both upper and lower platens are 14 inches square and are fitted with T-slots for quick clamping and easy alignment of the welding dies. For work requiring a quick follow-up, the welder slide can be fitted with a low-inertia head built into the slide and controlled by an air cylinder. 72



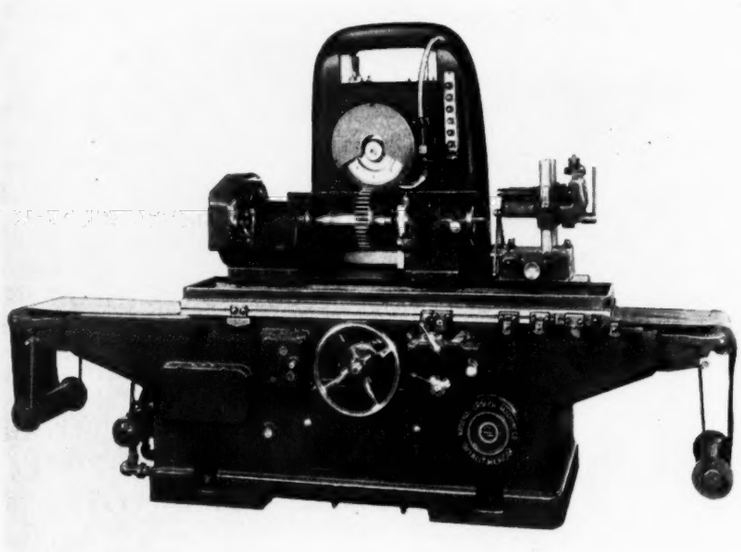
Heavy-duty Projection Welding Machine Built by the Federal Machine & Welder Co.

Red Ring Gear Grinding Machine

The National Broach & Machine Co., 5600 St. Jean Ave., Detroit, Mich., has placed on the market a Red Ring gear grinding machine that was originally developed for the precision grinding of master gears and involute broaches in the company's own plant. The machine is of very rigid design, having a U-type column and a wheel-spindle that is mounted on long bearings and is integral with the motor rotor.

The spindle slide can be adjusted vertically by a handwheel. A hydraulic counterbalance eliminates all backlash of the lead-screw, and operation of the down feed against hydraulic pressure prevents the head from sticking when small increments of down feed are employed. The table slide is hydraulically reciprocated and automatically controlled by a feed-box on the front of the machine. A cam on the table slide provides force-feed lubrication to the ways at each stroke. The combination vee and flat ways are covered at all times by a canvas roll.

The index-head is furnished with either fully automatic or semi-automatic control. For gear-tooth work, a templet control trimmer is provided which trims both sides of the wheel simultaneously. The table feed-box is provided with a positive



Red Ring Gear Grinding Machine Developed for Precision Grinding Operations on Master Gears and Involute Broaches

To obtain additional information on equipment described on this page, see lower part of page 154.

stop which brings the wheel to the trimming position, so that the diamond points operate exactly in line with the center of the wheel. The radius trimmer is mounted in the tailstock. Diamond points are adjustable up and down, and can be set with a micrometer. Both the coolant and the hydraulic pumps are located on the outside of the machine for accessibility, while the reservoirs are within the base.

The grinding time is considerably reduced when the gears are shaved before hardening and grinding, previous to lapping. In one instance, a gear 12 inches in diameter with a face width of 2 inches, which normally required sixty minutes for grinding, is being ground and lapped on the new machine in twenty minutes. The shaving operation requires less time than the finish-cutting operation which has been eliminated by the use of the new grinding machine. 73

Vernon Precision Hand Milling Machine

The No. 0 hand miller recently added to the Vernon line of precision milling machines made by the Machinery Mfg. Co., 3636 Irving St., Vernon, Los Angeles, Calif., is especially designed for high-speed milling operations on small parts. This machine is equipped with hand-lever operated rack-and-pinion feed. Two speed ranges are available—100 to 1000 R.P.M. and 150 to 1500 R.P.M. The fully enclosed variable drive facilitates selecting the correct spindle speed for each job.

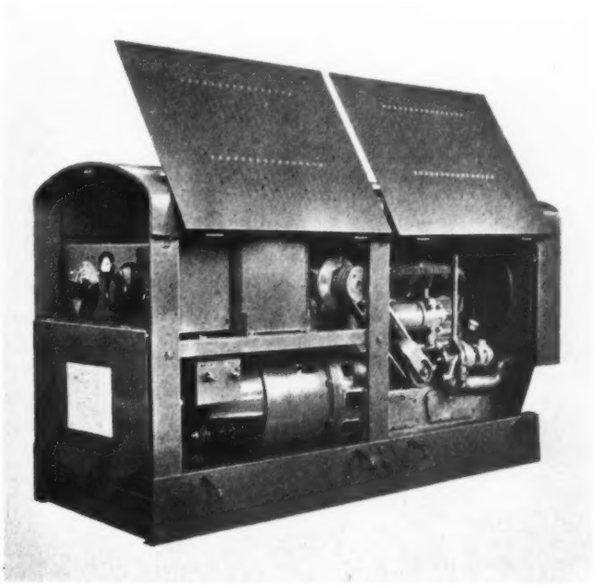
The spindle is mounted on Timken tapered roller bearings and has a No. 9 B&S taper. Power is provided by a 1/2-H.P., 1750-R.P.M., 60-cycle motor. A 3/4-H.P. motor is recommended for continuous high-speed operation. The machine weighs approximately 650 pounds, and has an over-all height of 58 inches. 74

Vernon Precision Milling Machine Designed for High-speed Operations on Small Parts

Diesel-Engine Driven Arc Welder with Gasoline Engine Starting Unit

Gasoline engine starting as applied to Diesel-engine driven arc welders of 300-ampere capacity previously brought out by the Lincoln Electric Co., Cleveland, Ohio, is now available on the 400-ampere model here illustrated. This arrangement provides for easy starting in any weather. Reports on Diesel welders operating under actual working conditions have shown cuts in fuel costs ranging from 33 to 86 per cent, with a fuel consumption of 1.5 gallons per hour at full load capacity, compared with a consumption of 2.75 gallons of gasoline for conventional gasoline-engine driven welders.

The small auxiliary gasoline starting engine is mounted above the Diesel engine. It is started by means of a hand-crank, the belt drive engaged by a clutch serving to connect the starting engine to the Diesel. Starting in extremely cold weather is facilitated by having the cooling system of the starting engine connected with that of the Diesel engine. The dual continuous control of the new welding machine enables the voltage and the current to be adjusted independently of each other. 75



Lincoln Diesel-engine Arc Welder with Gasoline-engine Starting Unit

Hand-Forged Punches

Hand-forged hand-punches for cutting round or any practical shapes or designs from sheet material, and a mallet for use with the punches, are being placed on the market by H. O. Bates, 251-257 N. Broad St., Elizabeth, N. J. The mallet is made up of a series of rawhide washers clamped in a cast-iron handle, and is furnished in several weights to suit requirements.

Press punches which are hand-forged to any practical shape from a wear-resisting tool steel, hardened, and then mounted on a steel backing plate for use in a foot or power press have also been brought out by this company.

Still another new product is a high-speed rotary punch for cutting accurate, round holes in resilient rubber and other pliable materials. In experimental tests, it has been found that tapering the cutting edges in a certain manner makes it possible to cut accurate, clean holes easily even in rubber. 76

Dial-Gage Holder

The Red E Set Co., 89 State St., Boston, Mass., has placed on the market a dial-gage holder with a ball-and-socket joint and a lever at the end of the gage-supporting arm that permits most of the adjustments to be made at

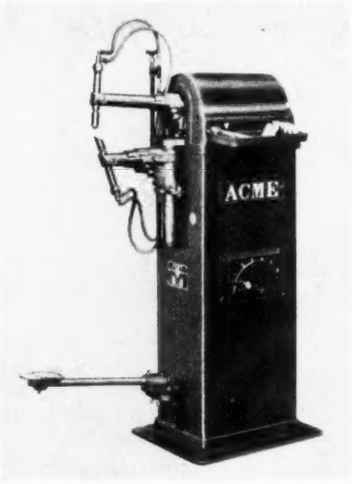
To obtain additional information on equipment described on this page, see lower part of page 154.

a distance of 5 1/2 inches from the gage. A secondary adjustment enables the tubular arm and gage to be adjusted vertically on the upright attached to the 3/8-inch square base that fits the toolpost of a lathe or supports the indicator when it is used on a machine table or surface plate. The ball-and-socket joint permits the contact point of the gage to be adjusted to touch almost any spot on the surface of a sphere. 77

Acme "Hot Spot" Welders

The Acme Electric Welder Co., 5621 Pacific Blvd., Huntington Park, Calif., has brought out a new line of foot-operated rocker-arm type spot-welders with all-welded fabricated steel bases. The Type 0 welder with stationary lower horn-holder, and the Type 1 welder with a swivel lower horn-holder are manufactured in 10-, 15-, and 20-KVA. capacities, and in throat depths of from 12 to 36 inches. These machines are furnished with water-cooling equipment.

A clamping-block device retains the horns in the horn-holders with an efficient electrical contact, yet a half turn of a 5/8-inch set-screw instantly releases the horns for a change in set-up. The horns are of the universal double-end reversible type, one end being machined to hold electrodes at an angle of 90 degrees, while the opposite end is machined to hold the electrode at an angle of 22 1/2 degrees. Other spot-welders in the line include foot-operated machines in capacities up to 75 KVA., and air-operated production machines up to 500 KVA. 78

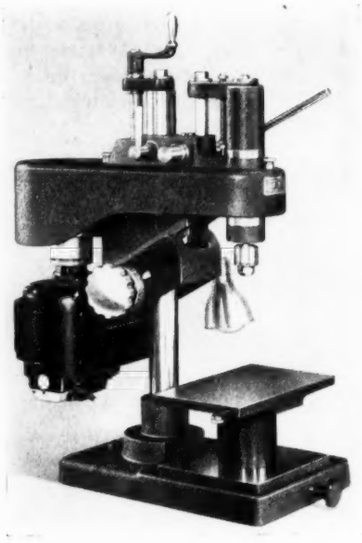


"Hot Spot" Welder Built by the Acme Electric Welder Co.

Hamilton Sensitive Drilling Machine

The "Varimatic" super-sensitive drilling machine recently brought out by the Hamilton Tool Co., Hamilton, Ohio, provides infinitely variable speeds ranging from 840 to 9300 R.P.M., through a constant-speed motor operating at 1725 R.P.M. Two ranges of speed are obtained by means of two-step pulleys on the driving and driven shafts. This arrangement gives the slow range of speeds required for the larger drills and a higher range of speeds for the smaller drills down to 0.004 inch in diameter.

A graduated dial on the speed-changing handwheel indicates the speed at which the spindle is operating. This machine is built for use on accurate tool-room work, including instrument, Diesel engine, electrical, aircraft, and other precision manufacturing.

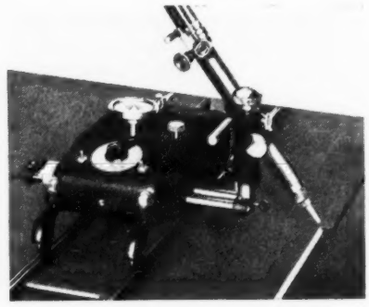


Sensitive Drilling Machine Made by the Hamilton Tool Co.

The drilling unit is self-contained, swings radially on the column, and can be locked in any position. All controls are manually operated. The 6 1/2-inch vertical adjustment of the drilling unit is obtained by means of an elevating screw. 79

Harris Portable Cutting Machine

The Harris Calorific Co., 5501 Cass Ave., Cleveland, Ohio announces an improved Model K portable, gas, metal-cutting machine adapted for cutting steel of light or heavy section. This machine is driven by a universal electric motor, and will cut to straight lines of any length with square or bevel edges. It will also cut circular work from 1 to 68 inches in diameter with standard equipment. It has a traversing speed range of from 3 to 60 inches per minute, forward or backward. An instant stop arrangement permits cutting to sharp angles, and a tracing feature provides for cutting irregular forms. A switch permits instant reversal. Mounting facilities for two torches are provided.



Harris Motor-driven Portable Cutting Machine

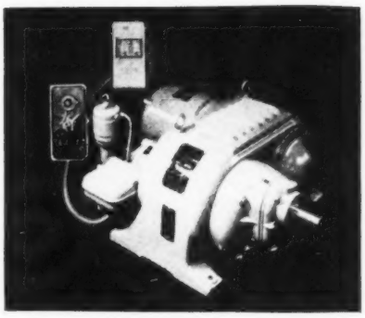
Traction for the traveling movement is obtained through two large-diameter hardened drive wheels. The swivel follower wheels provide four-point support. A one-point oil-feeder line to all bearings provides lubrication. Torches designed for the use of acetylene, propane, natural gas, and other fuel gases, in combination with oxygen, are available for use with this machine. The regular equipment includes cutting torch and tip, universal torch mounting, circular cutting attachment, and a 5-foot track. The complete machine, with torch, weighs 45 pounds. 80

"Varidrive" Motor with Remote Control

A new system of electric remote control has been adapted to the "Varidrive" motor made by U. S. Electrical Motors, Inc., 80 Thirty-fourth St., Brooklyn, N. Y. This device makes possible the automatic control of the take-off shaft speed by means of a thermostat, float switch, or other control.

The control consists of a small worm-gear reducer mounted on the Varidrive case and connected to the control shaft which changes the speed. The pilot motor is operated by thermostat, float switch, or sim-

To obtain additional information on equipment described on this page, see lower part of page 154.



"Varidrive" Motor Equipped with Electric Remote Control

ilar control through a relay or process timer. The thermostat or float switch controls the direction of the speed change, while the cyclic relay governs the rate at which the speeds are changed. This new system is being used in the ventilating and heating industries, as well as in many other industries requiring automatic speed control. 81

Screw Machine Cams Made from Synthetic Plastics

Screw machine cam blanks are now being made from a synthetic plastic material by the Synthane Corporation, Oaks, Pa. By using a synthetic plastic for the cams, it is possible to make a set of cams in much less time than is usually required. A small, wood-cutting band saw, a disk sander, and a filing machine constitute the equipment required for forming a complete set of cams from Synthane. Cam blanks of this easily worked plastic material are furnished in sets of three for sizes 00, 0, and 2 machines.

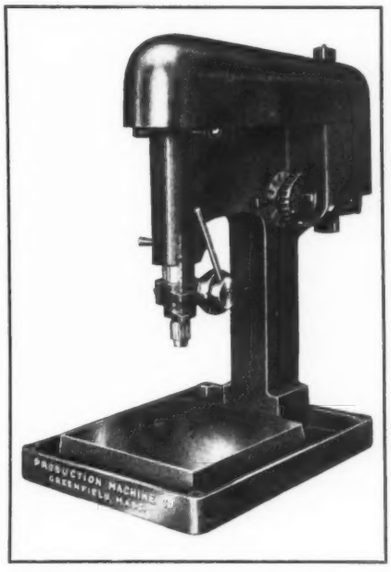
These cams are said to be suitable for all but the heaviest feeds. They are especially recommended for short runs, because they are so easily and quickly cut. In fact, it has become possible, when these cams are used, to set up an automatic screw machine for many jobs that formerly would not have been considered practicable to handle on automatics.

It is stated that Synthane cams have given excellent service on long runs—runs of 4,500,000 pieces being mentioned—and that the cams have been as good as new after the run. The Synthane Corporation states that while these blanks have just been put on the market, they have been used in actual production work in the company's own automatic screw machines for over ten years. 82

Reed Sensitive Bench Drill

The Production Machine Co., Greenfield, Mass., has just brought out a No. 25 streamline, high-speed, sensitive bench drill, which is the latest addition to the line of Reed sensitive drills that this company is now building. This new drill is designed to have unusual strength, and is intended for use as an all-purpose machine, capable of unusual speed and adapted to a wide variety of drilling operations. It is easy to handle, economical to operate, and particularly adapted for accurate production work.

The drive is completely enclosed, the only exposed moving parts being the chuck and drill. Although entirely enclosed, all parts are readily accessible. The new variable-speed drive embodies an infinitely variable spindle speed range of from 2000 to 10,000 R.P.M., any speed within this range being instantly available by turning a handwheel. An indicator shows the operating speed. 83



Reed Streamline Sensitive Bench Drill Built by the Production Machine Co.

Johnson Flat-Top Die Truck

The O. Johnson Co., Department M, 6027 W. Roosevelt Road, Cicero, Ill., has added two new flat-top die trucks known as "Feeder Trucks" to its line of "Multiduty" die trucks and portable work-benches. Simplicity and ease of operation are features of these sturdy trucks of electrically welded construction. They are particularly adapted for use in tool, die, and machine shops for transferring, transporting, and supporting work, being especially designed to prevent accidents and save time in operating punch presses.

Two sizes—Style F-1 and Style F-2—are available. The Style F-1 truck has a table 28 by 40 inches, which can be raised to a maximum height of 40 inches above the floor or lowered to within 24 inches of the floor. The safe load capacity of this table is 3000 pounds.

The Style F-2 truck has a table 24 by 32 inches, a safe load capacity of 2000 pounds, and weighs 325 pounds. The range of the table heights from the floor is the same as for Style F-1. Both sizes are equipped with ball-bearing, heavy-duty, rubber-cushioned casters. 84

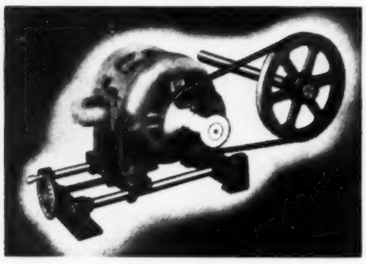
Unbreakable Loose-Pulley Oiler

A new visible, unbreakable, loose-pulley oiler has been placed on the market by the Trico Fuse Mfg. Co., 2948 N. Fifth St., Milwaukee, Wis. This oiler is designed to replace common grease or oil cups, and is available in 1- and 2-ounce capacities, with 1/8- or 1/4-inch pipe thread fittings.

The new oiler is designed to operate at fast or slow speeds without flooding. A copper tube transmits heat from the pulley hub to the oil reservoir to produce quick thermal action, the wire-reinforced wick feeds oil by capillary action, and the oil is dropped on the bearing by gravity. The oiler requires no attention except for the occasional refilling of the reservoir. 85

Unbreakable, Loose-pulley Oiler Made by the Trico Fuse Mfg. Co.

To obtain additional information on equipment described on this page, see lower part of page 154.



"Vari-Speed Jr." Control Unit Made by the Reeves Pulley Co.

Reeves "Vari-Speed Jr." Speed Control Unit

The Reeves Pulley Co., Columbus, Ind., has recently added a "Vari-Speed Jr." unit to its line of variable-speed control equipment. This new unit is designed to provide even the smallest and lightest machinery with variable-speed control. Any constant-speed motor, from fractional up to 1 1/2-H.P. size, can be easily converted into a variable-speed unit with this equipment.

The unit, as regularly furnished, comprises a disk assembly and adjustable motor base. The disk assembly has two cone-shaped disks, one stationary and one laterally adjustable; a self-adjusting tension spring; a spring adjusting nut; and a cover. This assembly is applied directly to the standard shaft extension of the motor, which is mounted on an adjustable base. The V-belt between the two disks and the sheave pulley is of the standard section A or B type.

The motor can be moved forward and back by means of a handwheel. When nearest to the driven sheave, the V-belt runs over the largest diameter on the disks and maximum speed is secured. Turning the handwheel in the reverse direction moves the motor away from the driven sheave, thus reducing the speed, since the V-belt forces the movable disk outward so that the effective diameter of the driven sheave is reduced. Minimum speed is obtained when the motor is farthest from the driven sheave.

The "Vari-Speed Jr." is built in six different sizes of disk assemblies for use with motors of from 1/8 to 1 1/2 H. P., and provides speed control over a range of from 1 3/4 to 1 up to 2 3/4 to 1, inclusive. 86

Oxweld Regulators for Welding and Cutting Operations

The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, 30 E. 42nd St., New York City, has added three single-stage, general-service regulators to its Oxweld line of welding and cutting equipment. These regulators—the Oxweld R-80 oxygen regulator for the delivery of oxygen at working pressures up to 200 pounds per square inch, its companion acetylene regulator, the Oxweld R-81, and the Oxweld R-82 fuel gas regulator—have been designed with a view to obtaining simplicity of construction and reliability of operation. They are adapted for all welding, cutting, and descaming operations where simplicity of construction and large capacity are demanded, but where the refinements of the Oxweld two-stage regulators are not required.

(Left) Oxweld R-80 Oxygen Regulator. (Right) Oxweld R-81 Acetylene Regulator

The R-80 and R-81 regulators are of the stem type—that is, the valve closes with the incoming pressure, thus assuring positive seating action. The passageways are of sufficient size to permit unrestricted flow of gases. In addition, the R-80 oxygen regulator has a special inlet screen, formed of a double thickness of fine mesh, for filtering out dirt and foreign particles. The Oxweld R-82 fuel gas regulator, which is also of the stem type, is intended for use with various gases, such as "Pyrofax," propane, and butane. 87

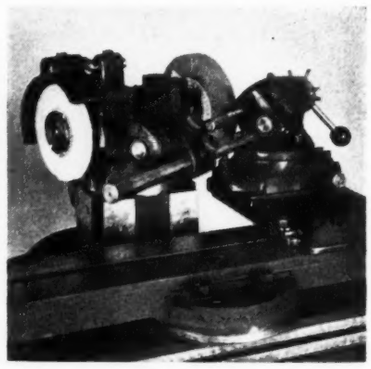
Thor Electric Bench Grinders

Three electric bench grinders have recently been placed on the market by the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. The three sizes cover 6-inch light-duty, 6-inch heavy-duty, and 7-inch heavy-duty machines. The motors are completely enclosed, and have dust-tight ball bearings which require greasing only about once a year. 88

Covel Tap Grinding Attachment

A wide variety of sizes and styles of taps can be speedily and accurately chamfer-sharpened on the new No. 2 attachment recently brought out by the Covel Mfg. Co., Benton Harbor, Mich. This attachment can be easily mounted on any grinding machine having a wheel with a face not more than 1 1/4 inches wide, longitudinal and transverse adjustment similar to a universal cutter and tool grinder, and a flat table 4 1/2 to 6 1/2 inches wide. The set-up can be quickly changed to accommodate any size of tap within its capacity. Small taps from No. 6 to 1 1/2 inches are held in a three-jaw chuck, while larger taps are held on centers during the grinding operation.

The attachment is first set up and securely fastened to the grinding machine, and then adjusted for the kind and size of tap to be ground. Next, the face of the flute is aligned with a lip rest, and the amount of eccentric relief is adjusted. Grinding is accomplished by rocking the Bakelite ball knob back and forth.



Covel Tap Grinding Attachment Mounted on Universal Cutter and Tool Grinder

To obtain additional information on equipment described on this page, see lower part of page 154.

The oscillating spindle revolves in ball bearings, allowing the operator to "feel" the cutting action of the grinding wheel. When one tooth has been ground, the tap is indexed to the next tooth by locating it from the lip rest in the case of large taps, and by ratchet stops in the tailstock in the case of small taps. The attachment handles taps from No. 6 to 2 inches in diameter, and in lengths up to 12 inches, with two, three, or four flutes. It weighs approximately 50 pounds. 89

Ozalid Fast-Printing "Whiteprint" Machine

A new Model F "Whiteprint" machine has just been placed on the market by the Ozalid Corporation, Johnson City, N. Y. This equipment consists of a printer and a dry-developing unit, built into a single compact machine which has all the facilities necessary for turning out dry-developed Ozalid white prints.

A new type high-pressure mercury vapor lamp is employed which enables Ozalid sensitized materials to be printed at speeds up to 56 inches per minute. The lamp gives uniform light distribution over the entire printing surface and is guaranteed for 100 hours' operation. Tests have indicated, however, that this lamp has a life of from 1500 to 2500 hours. Burned-out lamps can be reconditioned for considerably less than the cost of a new lamp. It is claimed that the new light source reduces electrical consumption more than 50 per cent.

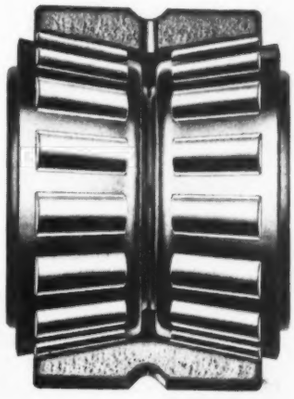
An adjustable light shade allows the operator to vary the exposure without changing the printing speed. This permits a smooth flow of work to be maintained regardless of variations in the tracings. 90

Ozalid Machine with Complete Equipment for Making Whiteprints

Timken Two-Row, Double-Cup, Slotted Tapered Roller Bearing

The Timken Roller Bearing Co., Canton, Ohio, has recently placed on the market a non-adjustable roller bearing that is a modification of the regular NA type made by this company. The new bearing is made up of a double-row outer race or cup, and two single-row inner races or cones, and is especially adapted for use as a sheave bearing.

These bearings are designed to have a minimum width, an inside diameter that is large in relation to the outside diameter, and a maximum radial and thrust capacity for the space occupied. Being an anti-friction thrust bearing, as well as an anti-friction radial bearing, the sheaves are allowed to rotate freely without axial float. Wear between the sheaves and the side plates is eliminated by this construction. The tapered races of the two rows of rolls being directed one toward the other, results in a bearing of extreme rigidity which prevents wobbling of the sheave. 91



Timken Two-row Tapered Roller Bearing

"Mototrace" and Special Tracer for Profilometer

The Physicists Research Co., 343 S. Main St., Ann Arbor, Mich., has recently developed two new accessories for use with the profilometer previously brought out by the company for measuring surface roughness. The device, known as the "Mototrace," provides mechanical operation of the profilometer tracer, which is moved across the surface tested. This device has four specific applications. It is used when the tracer is employed on very narrow surfaces or small areas where the available tracing distance is only 1/32 to 1/8 inch; in places near shoulders or holes where the tracing distance is restricted; on very smooth surfaces of 1/32 to 2 microinches; and in cases where vibration makes manual tracing difficult.

Profilometer Equipped with New "Mototrace" and Special Tracer

A special tracer designated Type 1 has been developed for measuring roughness inside of holes as small as 1/2 inch in diameter. This tracer is also useful for measuring the roughness of gear teeth and other surfaces that are difficult to reach. For especially fine work, such as gages, three times the sensitivity of the standard model profilometer is obtained by incorporating an extra point in the range switch. 92

Automatic Molding Machine for Threaded Plastic Parts

An automatic molding machine brought out by the F. J. Stokes Machine Co., 5930 Tabor Road, Philadelphia, Pa., is provided with an "unscrewing device" by means of which threaded plastic moldings are produced in an automatic cycle at rates up to 1000 per mold cavity per day. Either internal or external threads of any desired pitch can be molded, the speed of the unscrewing device being adjustable to suit the pitch of the thread. The unscrewing and ejection takes place at the same time that the mold is opening. Thus there is no loss of time or lengthening of the molding cycle in the production of threaded parts. 93

Cutler-Hammer Drum-Type Master Switch

A drum type master switch providing three-wire control for machine tools and similar equipment has been developed by Cutler-Ham-

To obtain additional information on equipment described on this page, see lower part of page 154.

mer, Inc., 315 N. 12th St., Milwaukee, Wis. The new switch performs functions equivalent to those of two- and three-button heavy-duty push-button stations, and is intended for use where an operating lever is preferred. It is available for surface, cavity, and panel mounting, and with two types of handles—standard or pistol grip. The ratings of the new switch are for pilot circuits up to 600 volts, alternating or direct current. 94

Oilgear Pumps Adapted for Remote Control

Two-way, electrically controlled, variable-displacement pumps are now being manufactured in conventional sizes from 2 to 150 H.P. by the Oilgear Co., 1315A W. Bruce St., Milwaukee, Wis. Since these new Type DX pumps are especially adapted for remote, finger-tip, push-button control, and greatly simplify the oil circuit and piping, they are being used as standard equipment on all styles of Oilgear broaching machines.

Easy operation, accurate control of volume, smooth acceleration and deceleration of the oil flow, automatic protection against overload, and automatic lubrication of working parts make these units especially suitable for operating push- and pull-broaching machines, forming, assembling, forcing, broaching, extruding, and speed presses, and similar equipment.

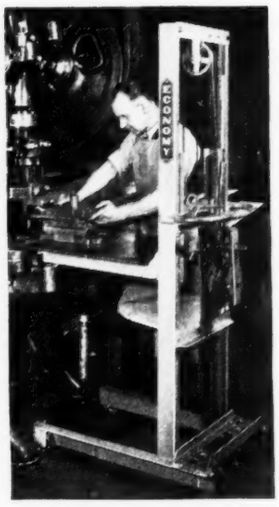
These heavy-duty, radial, rolling-piston type pumps utilize oil as the fluid power medium. The internal pumping mechanisms provide for normal working pressure ratings of 1100, 1700, and 2500 pounds per square inch and for peak pressures up to 3000 pounds per square inch. All pumps are arranged for flanged mounting to a separate reservoir base or reservoir integral with the machine.

One of the six Oilgear Type DX-10025 pumps recently built for operating large high-speed presses is shown in Fig. 1 mounted on a reservoir base and direct-connected to a 75-H.P. electric motor. The amount of oil delivered by this pump can be varied from 0 to 16,500 cubic inches per minute in either direction at peak pressures up to 3000 pounds per square inch, while no oil is delivered when the pump operates in the neutral position.

In Fig. 2 is shown an Oilgear Type DX-15025 pump in combination with an Oilgear Type C-15025 pump connected to a double-end, 250-H.P. direct-current motor that will deliver 50,000 cubic inches of oil per minute at pressures up to 3000 pounds per square inch for operating a 150-ton, deep drawing press with a 60-inch stroke. 95

"Shop Lifter" for Handling Dies and Fixtures

A "Shop Lifter" designed to facilitate moving heavy dies in and out of presses and storage racks without danger of injury to the operator or damage to the parts, has been brought out by the Economy Engineering Co., 2653 W. Van Buren St., Chicago, Ill. With this lifter, a man can easily pick up a die, transport it through the plant, and lift it into a press or storage space. The entire operation is thus performed safely and easily. The lifter can also be used for raising heavy metal parts, for stacking boxes, skids, or drums, and as an adjustable table for machine work or as a truck for material-handling.



"Shop Lifter" Built for Handling Dies

A sturdy hand-operated hoist raises and lowers the platform to any desired height within the limits of travel, and an automatic clutch holds the platform at any height until it is moved by means of a crank. The lifter has a capacity of 500 pounds. The platform can be raised 57 inches above the floor level and lowered to within 8 1/4 inches of the floor. The steel-plate platform is 24 inches square. 96

Lima Gear-Shift for Motor

A new automotive type gear-shift which provides for instant changing of speed without shifting belts has been developed by the Lima Electric Motor Co., a subsidiary of the Lima Armature Works, Inc., 440 N. Main St., Lima, Ohio. The gear-shift is built to give three speeds forward and one reverse, or four speeds forward and reverse with the aid of a reversing switch. It is built as an integral part of the motor, and also as a gear-shift drive applicable to any standard motor. A bracket for mounting the gear-shift on a lathe is also available.

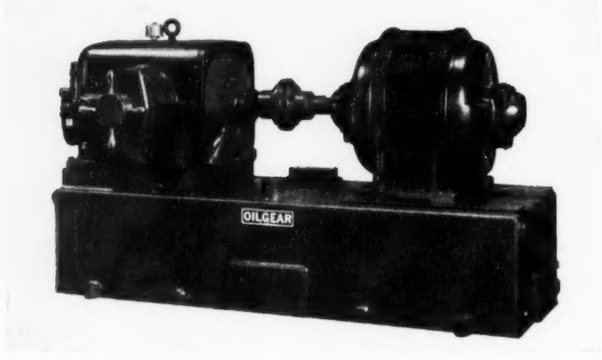


Fig. 1. Oilgear Pump Mounted on Reservoir Base and Connected to 75-H.P. Motor

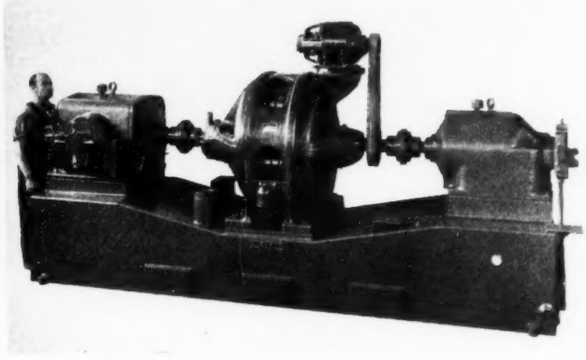


Fig. 2. Oilgear Pumps with Capacity of 50,000 Cubic Inches per Minute

To obtain additional information on equipment described on this page, see lower part of page 154.

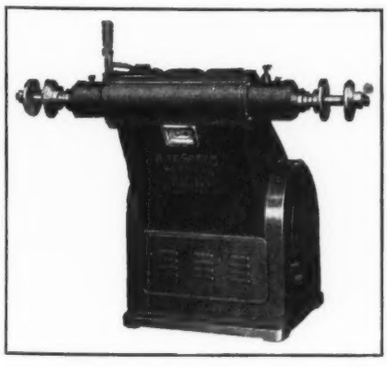
Lima Automotive Type Gear-shift

This new gear-shift is adapted for use on lathes, milling machines, planers, drill presses, grinders, and other machines that require speed changing. The gear-shift drive alone is normally installed on machines that are already driven by an individual motor. 97

Hammond Polishing Lathe

The Model 10-ROH machine here illustrated is a new addition to the "Rite-Speed" line of polishing and buffing lathes built by Hammond Machinery Builders, Inc., 1619 Douglas Ave., Kalamazoo, Mich. This lathe is especially designed for use on large bulky pieces. It has an overhanging spindle, the front section extending beyond the base 12 1/2 inches.

The regular equipment includes a lock for holding the spindle stationary while changing wheels, a combination switch and brake which shuts off the motor and instantly stops the revolving spindle, an automatic motor starter, and a motor up to 10 H.P. with multi-V belt drive mounted inside the base. 98



Hammond Polishing Lathe with Overhanging Spindle

Skilsaw Disk Sanders

Three new sanders have been added to the line of portable electric disk sanders made by Skilsaw, Inc., 5039 Elston Ave., Chicago, Ill. The new Model SP, two-speed, heavy-duty sander and polisher has been developed especially for use in metal-fabricating plants where a variety of sanding, polishing, and buffing operations are performed. Maximum sanding efficiency is obtained when this sander is operating at a speed of 4200 R.P.M. This tool is especially useful for rubbing down lacquered surfaces and for other polishing operations when equipped with felt rubbing pads or lamb's wool polishing bonnets, and operated at a speed of 1300 R.P.M. This model

Model H2 Heavy-duty Sander

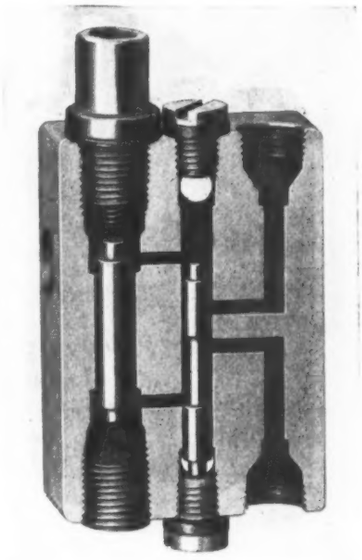
is 18 1/2 inches long and weighs 14 3/4 pounds.

The Model H2 two-speed sander is designed for economical operation under continuous use. A 9-inch disk can be used at a speed of 2700 R.P.M., and when worn down, can be resized to a diameter of 7 inches and used at a speed of 4200 R.P.M. This model is 19 1/2 inches long and weighs 16 pounds.

The Model SL is an extra-heavy power unit designed to handle a wide variety of heavy-duty sanding, grinding, and surfacing operations. It operates at a no-load speed of 5000 R.P.M. and uses 6-inch wheels. Various sanding pads, grinding wheels, wire cup brushes, and other accessories can be employed. This tool is 18 inches long and weighs 15 pounds. 99

Farval "Dualine Jr." Centralized Lubrication

A new development in centralized lubrication known as the "Dualine Jr." system, has been announced to the trade by the Farval Corporation, 3276 E. 80th St., Cleveland, Ohio. The new unit operates on the same "piston displacement principle" of measurement employed for the last twelve years in the large "Dualine" systems used on heavy machines, but the size has been greatly reduced for correct application to small machine tools and other equipment.

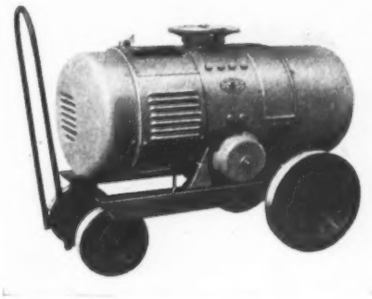


Farval Valve for Lubricating System

A line of fittings, hose, couplings, and other accessories has been developed for use with the smaller units. The accompanying sectional view shows the valve block full size. The "Dualine Jr." valve has two moving parts; it contains no springs and no check-valves, and is fully adjustable. 100

Wilson Dual Voltage Switch for Arc Welders

The Wilson Welder & Metals Co., Inc., 60 E. 42nd St., New York City, has just placed on the market a dual

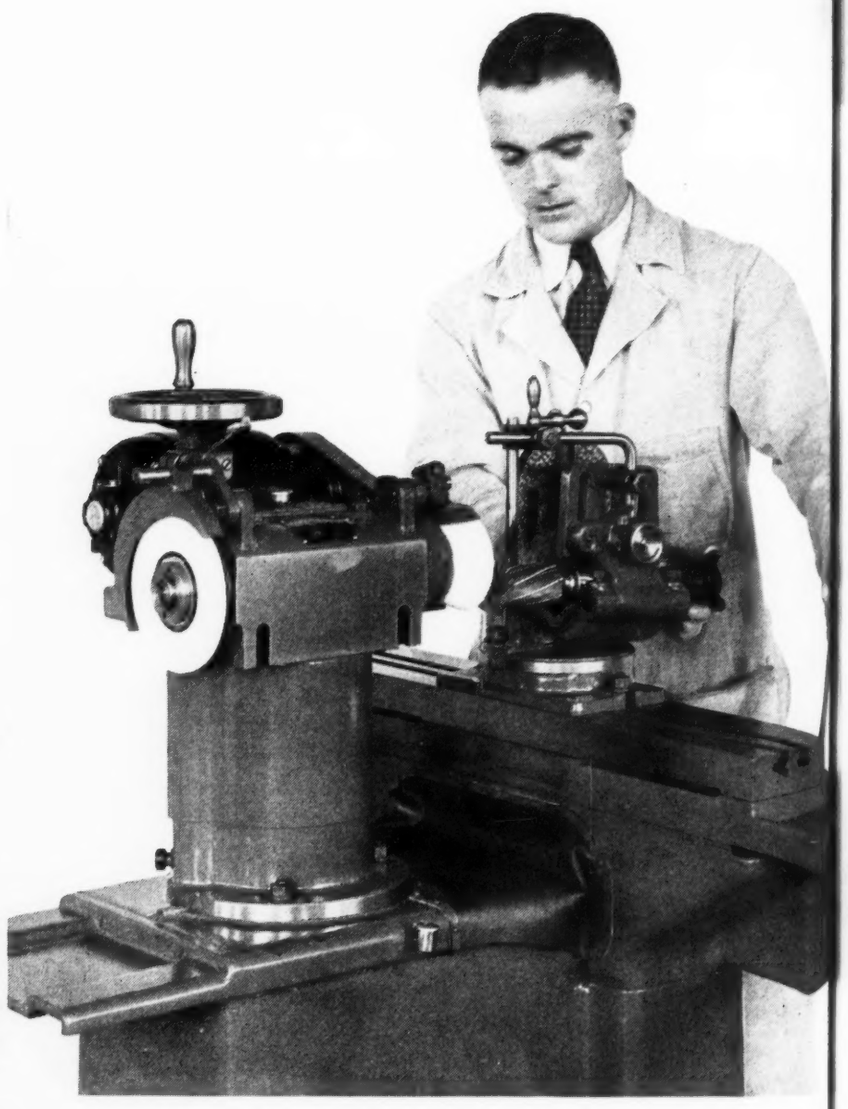


Wilson "Hornet" Welder Equipped with Dual Voltage Switch

To obtain additional information on equipment described on this page, see lower part of page 154.

MODERN CUTTER AND

At right — Sensitive, easily operated controls and convenient adjustments of the No. 10 simplify accurate cutter and tool sharpening.



At left — A wide selection of additional equipment, such as the Wet Grinding Attachment shown, adapts the No. 13 to practically every type of tool-room grinding operation.

BROWN &

TOOL GRINDING REQUIRES *EXACTING* MACHINES

— No. 10 Cutter & Tool Grinding Machine

- - to improve the production of your milling departments by keeping cutters in efficient cutting condition.

— No. 13 Universal & Tool Grinding Machine

- - for general purpose toolroom grinding, sharpening cutters, reamers and other cutting tools — and for small cylindrical work.

Simplicity of design – ease of set-up and operation – wide versatility – long-lived accuracy . . . features which mean reduced costs and fast and accurate output – all are found on both these money-saving machines. Ask for literature which includes complete description of the many available attachments. Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

B·S

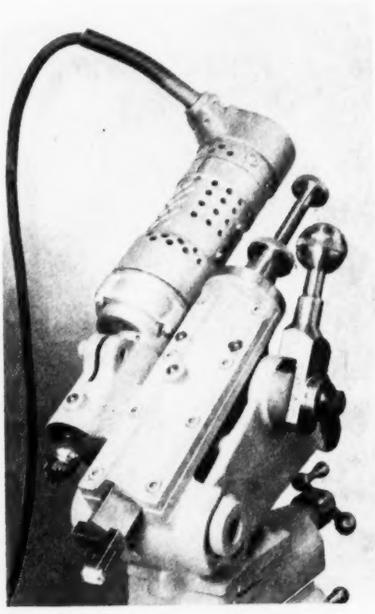
BROWN & SHARPE

voltage switch for arc-welding machines, such as the Wilson "Hornet," for use when the welders must be operated on two different line voltages. The new switch, known as Type CH, can be used on any motor employing alternating current, provided the motor and starter can be reconnected for two voltages.

Normally, the adjusting of a motor to operate on a different line voltage requires changing the heater elements and disconnecting and reconnecting the motor and magnet coil leads. This operation takes from one-half to two hours. With the switch installed, however, the change can be made in less than a minute. Figures on the base show the voltage for which the switch is set. 101

Foster Light-Duty Superfinishing Attachment

A size 0 superfinishing attachment designed to be mounted on the compound rest or cross-slide of a lathe has been placed on the market by the Foster Machine Co., 802 Foster Bldg., Elkhart, Ind. This new attachment is intended for superfinishing work in the fractional-inch diameter sizes. The pressure exerted by the stone on the work is provided by a very sensitive, easily adjusted spring.



Foster Superfinishing Attachment for Handling Small Work in a Lathe

The superfinishing stone is retracted by a lever which does not disturb the stone setting. Oscillation is imparted to the stone in a straight-line movement by a small gear motor. Similar attachments are also furnished for larger size work, such as automotive crankshafts. ..102

Contour Boring of Glass Bottle Molds

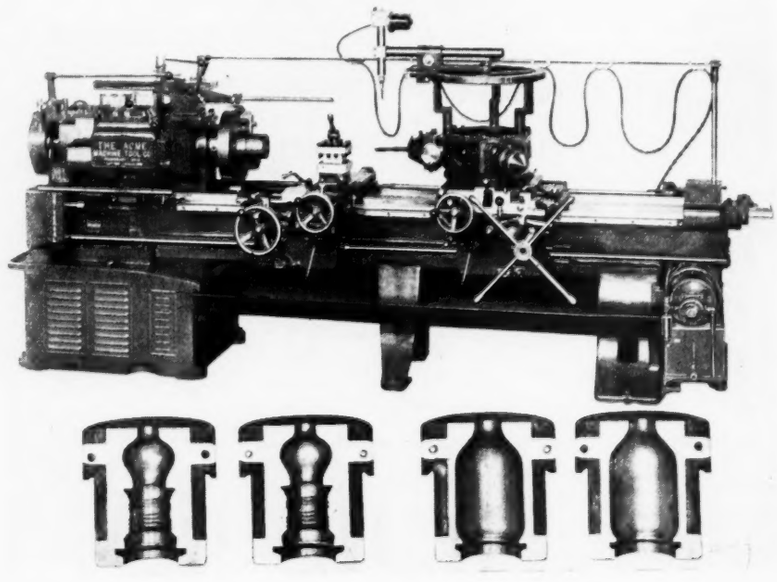
An interesting example of contour boring on a turret lathe equipped with a duplicating attachment is found in the production of cast-iron molds for glass bottles in a bottle manufacturing plant. The control mechanism for the boring operation is one made by the Detroit Universal Duplicator Co., Detroit, Mich. This mechanism actuates the cross-slide of the turret of an Acme turret lathe. Moving the boring-bar in conformity with a metal templet that duplicates the shape of the finished mold, the reproduction is done with such accuracy that, in addition to the savings obtained in actual production time, the costs of the molds are further reduced by less polishing and burnishing being required.

The two mold halves, as shown at the lower right of the accompanying illustration, are clamped together in the turret lathe by means of a chucking device. After facing one end, the operator moves the turret-mounted boring-bar to the starting position and then starts the duplicating control mechanism. When the internal cut is completed, the work is removed and reversed in the lathe to complete the mold by facing the opposite end.

The templet for the contour boring is mounted on the head of the lathe, and the tracer head is mounted on the turret. The tracing finger follows the templet and transmits a series of interrupted electrical impulses to the control unit, which, in turn, actuates the cross-feed of the boring-bar in exact conformity with the templet.

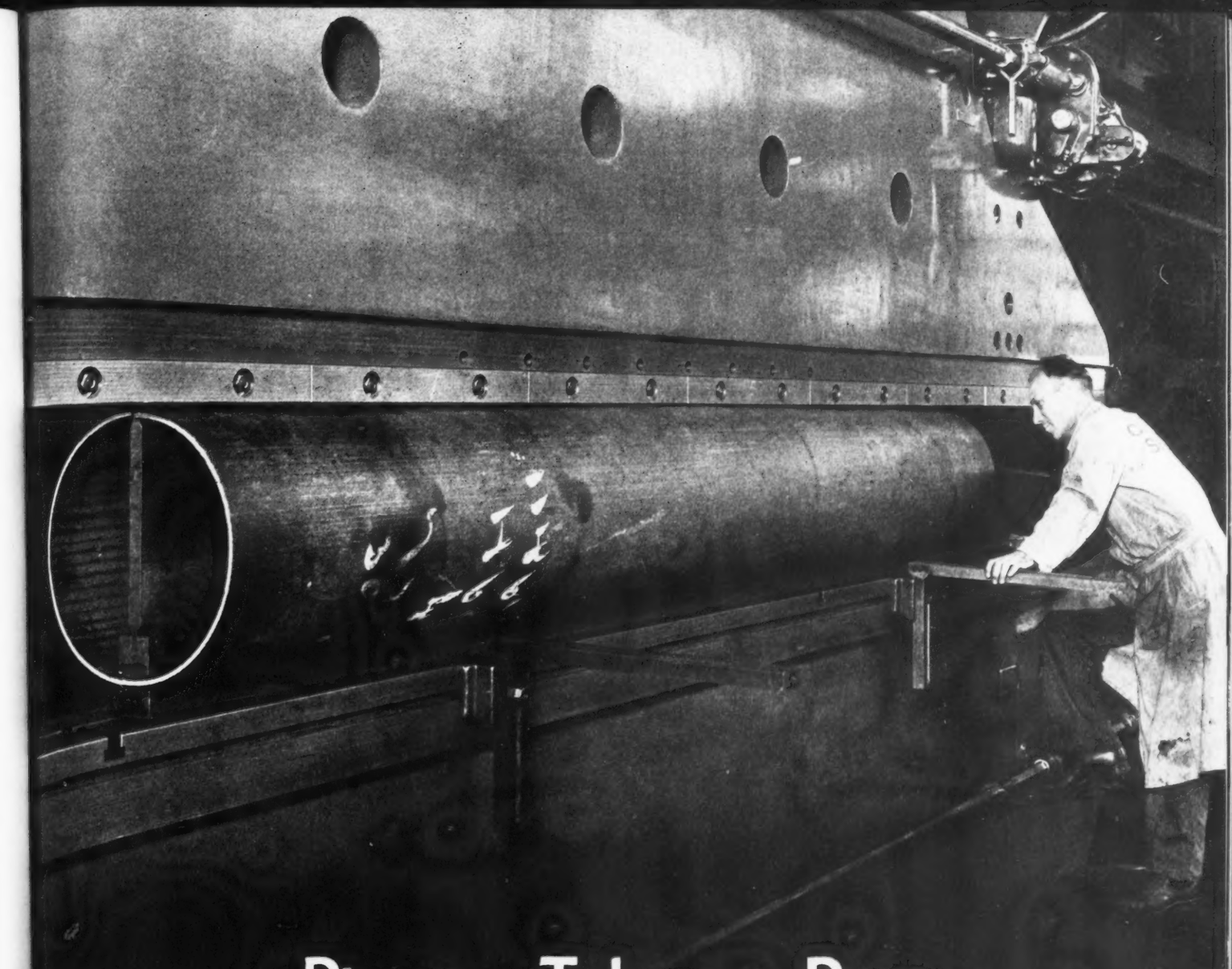
To assure close conformity of the work with the templet, a solenoid-actuated clutch, operated from the tracer head and mounted on the cross-slide feed, provides an exceptionally fine control for the feed of the cutting bar. An example of the close control possible with the solenoid clutch is shown at the lower left in the illustration. This mold was turned as indicated to prove the possibilities of the set-up. The accuracy of the control permits stopping the operation at any time without gouging the work.

This operation is an interesting example of what can be done with present duplicating equipment.



Detroit Universal Duplicator Control Unit Mounted on an Acme Turret Lathe for Producing Glass Bottle Molds by Contour Boring. The Illustrations in the Lower Right-hand Corner Show the Molds prior to Polishing. The Intricate Shapes Shown to the Left were Used to Test the Accuracy of the Duplicating Control

To obtain additional information on equipment described on this page, see lower part of page 154.



Pipes . . . Tubes . . . Posts

. . . are easily and accurately formed on Cincinnati Press Brakes.

Cincinnati Press Brakes are also used for crimping sheet and plate before rolling to eliminate flats at seam edges of rolled shapes.

Write for recommendations on your job.

THE CINCINNATI SHAPER COMPANY, CINCINNATI, OHIO

SHAPERS · SHEARS · BRAKES

NEWS OF THE INDUSTRY

Indiana and Illinois

BROWNING TOOL & SUPPLY CO., 225 W. Georgia St., Indianapolis, Ind., has been appointed exclusive representative for the GEOMETRIC TOOL CO., New Haven, Conn., in the Indianapolis territory. GEORGE LANGEN, JR., 1564 Wittekind Terrace, Cincinnati, Ohio, who handled this territory, as well as southern Ohio in the past, will handle Geometric products in southern Ohio and parts of Kentucky in the future.

HAYNES STELLITE CO., UNIT OF UNION CARBIDE & CARBON CORPORATION, Kokomo, Ind., is expanding its manufacturing facilities by the addition of a new 75- by 132-foot factory building, to be used in the manufacture of Haynes Stellite alloy products—metal-cutting tools, hard-facing rods, and special castings for resisting abrasion, corrosion, and heat.

CLAIRE C. BALKE has rejoined the research staff of the Fansteel Metallurgical Corporation, North Chicago, Ill. Mr. Balke became connected with the Fansteel organization immediately after his graduation from the University of Illinois, and was with the research laboratory until about a year ago, when he engaged in the establishment of a department of powder metallurgy at Stevens Institute of Technology, Hoboken, N. J.

M. J. TENNES, JR., has been elected president of the Shafer Bearing Corporation, 35 E. Wacker Drive, Chicago, Ill. Mr. Tennes has been vice-president and sales manager of the company for several years. A. H. WILLIAMS, chief engineer, has been elected vice-president, and RAY P. TENNES secretary and treasurer.

Michigan and Minnesota

FREDERICK COLMAN & SONS, INC., Detroit, Mich., manufacturers of tools, dies, and special machinery for the automotive and aviation industries, have awarded contracts for the design and construction of a $150,000 addition to the firm's plant at 7250 Central Ave., Detroit. The Austin Co., Cleveland, Ohio, is the builder.

TURCHAN FOLLOWER MACHINE CO., Detroit, Mich., maker of hydraulic duplicating attachments for machine tools, announces that the firm has moved from 3099 Humboldt St. to 8259 Livernois Ave., Detroit.

DAYTON ROGERS MFG. CO., Minneapolis, Minn., is expanding its plant by the addition of a one-story factory building which will house new machinery and other special equipment to be used in the manufacturing of metal stampings in small lots. This expansion will practically double the present production of the plant.

A. E. GRAPP has been elected president and treasurer of the Despatch Oven Co., Minneapolis, Minn., builder of ovens and furnaces for all purposes. H. L. GRAPP, F. H. FABER, and G. C. KEYES have been elected vice-presidents, and G. M. LUND secretary and comptroller.

New England

A. OAKLEIGH BUSH has been appointed assistant chief sales engineer of the Abrasive Division of the Norton Co., Worcester, Mass. Mr. Bush has been with the Norton Co. for sixteen years, first in the electric furnace plant at Niagara Falls, and then in the research and sales engineering departments at Worcester. In 1937, he was transferred to the Norton London office, and later to the English plant at Welwyn, becoming its acting general manager in 1939. He returned to Worcester about a month ago, together with other American members of the Norton Co.'s European staff.

W. H. MILTON, JR., who has been sales manager for the General Electric Plastics Department at Pittsfield, Mass., for the last two years, has been appointed assistant manager of that department. Mr. Milton has been associated with the General Electric Co. since 1920, when he became a member of the company's student engineering course.

DERICK S. HARTSHORN, JR., has been appointed technical director of the Enthone Co., New Haven, Conn., manufacturer of chemical products. Mr. Hartshorn has been associated with the Westinghouse Electric & Mfg. Co. at East Springfield, Mass., for the last seven years in the capacity of chemist.

HARTLEY WIRE DIE CO., formerly of Waterbury, Conn., has removed to larger quarters at Thomaston, Conn., thereby increasing by approximately 15,000 square feet the manufacturing floor space formerly available. The company produces Carboloy dies for drawing, sizing, and extruding purposes.

CHARLES J. MARKS has been appointed chief tool engineer of the United Aircraft Corporation, East Hartford, Conn. Mr. Marks will assist the vice-president in charge of operations in coordinating the planning of manufacturing facilities and tooling in the several divisions of the corporation.

ARTHUR A. MERRY and FREDERICK L. WOODCOCK have been appointed chief tool engineers of the Pratt & Whitney Aircraft Division and the Hamilton Standard Propellers Division, respectively, of the United Aircraft Corporation, East Hartford, Conn.

U. S. ELECTRICAL MOTORS, INC., Los Angeles, Calif., has begun construction on an eastern plant at Milford, Conn. The plant will be completed in November, and will be equipped for the production of electric motors of various types.

PRATT & WHITNEY DIVISION OF THE UNITED AIRCRAFT CORPORATION, East Hartford, Conn., has let contracts for the construction of two new aircraft engine test houses to be erected by the Turner Construction Co., of New York.

H. C. JACKSON, of the American Hardware Corporation, New Britain, Conn., has been elected chairman of the Credit Executives of the Hardware Manufacturing Industry.

New Jersey

CALLITE TUNGSTEN CORPORATION, Union City, N. J., has acquired HARRIS ALLOYS, INC., which will be conducted as a division of the Callite Tungsten Corporation, of which CHARLES H. KRAFT is president. FREDERICK T. HARRIS, formerly executive head of Harris Alloys, Inc., will join the Callite Tungsten Corporation's executive staff and have charge of the operations of the new division. The sales activities will be under the supervision of D. R. DONOVAN, general sales manager.

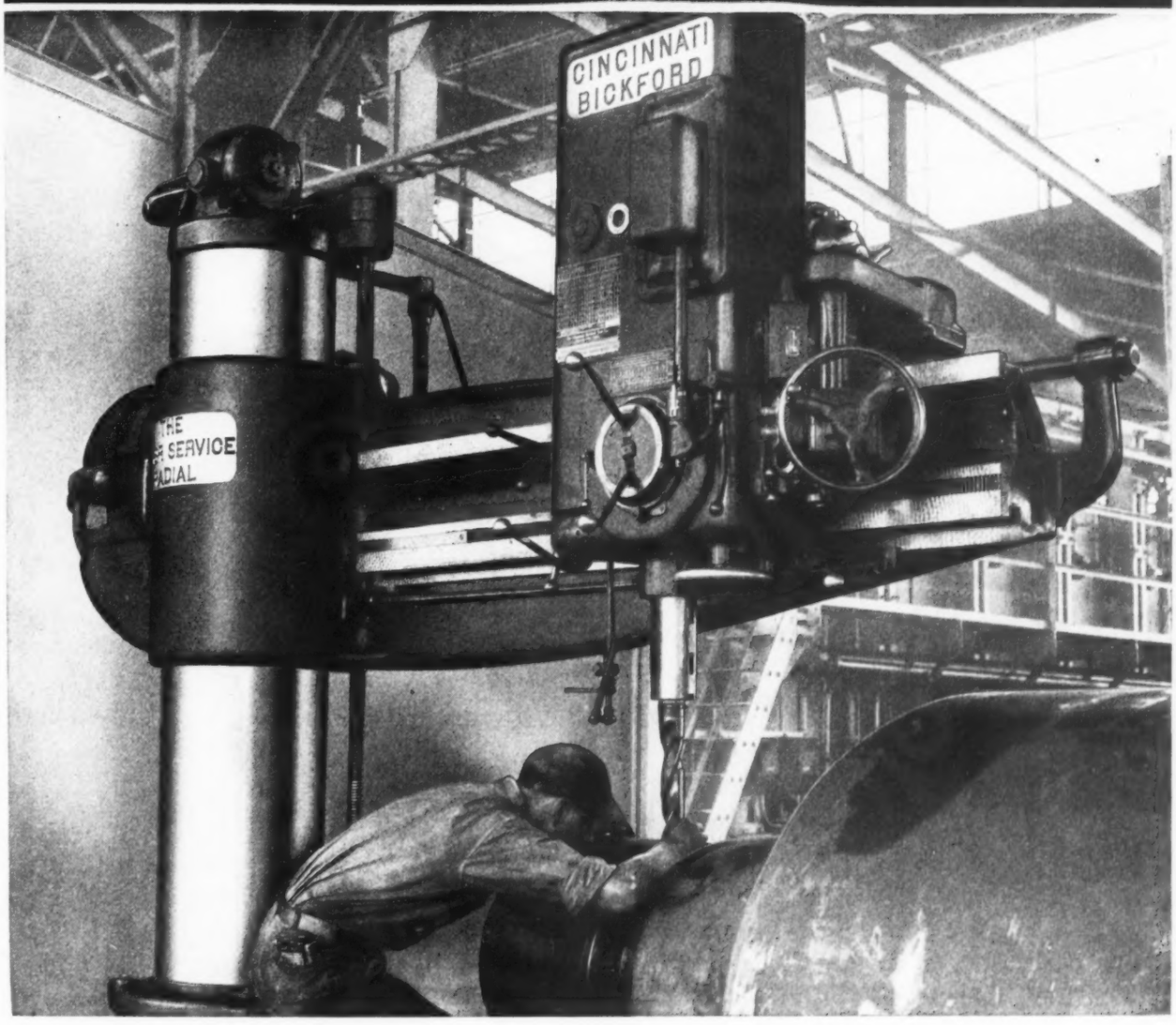
AIR ASSOCIATES, INC., have completed a new plant at Bendix, N. J., and are moving all the operations of the company from the buildings now occupied at Roosevelt Field, Long Island, to the new plant, which will provide a total floor area of 63,000 square feet.

New York

DR. W. D. COOLIDGE, director of the General Electric Research Laboratory, has been appointed a member of the newly organized National Inventors' Council, a body created by the Department of Commerce to encourage civilian inventions as part of the National De-

Throughout Industry...

THIS SUPER C B SERVICE TRADEMARK MEANS "MORE HOLES PER DOLLAR"!



MANUFACTURING A 44,000 LB. ROLL

The job shown is a sample of the heavy work this Super Service Radial performs in the building of massive rolling mill equipment at the plant of United Engineering & Foundry Co., Vandergrift, Pa.

For reasons explaining this machine's superiority, send for Bulletin R-24.

THE CINCINNATI BICKFORD TOOL CO.

OAKLEY · CINCINNATI · OHIO · U. S. A.

fense program. The Council, composed of twelve scientists and industrial leaders, will cooperate with the National Defense Research Committee.

JOHN N. HARPER has been added to the sales staff of Greene, Tweed & Co., 101 Park Ave., New York City, manufacturers of Basa hammers, Empire rawhide mallets, and reversible ratchet wrenches. He will be stationed in Pittsburgh, Pa., and will cover the western Pennsylvania territory. JOSEPH H. MALONEY will be stationed in Cleveland, and will cover the northeastern Ohio territory.

ANTHONY WILLIAM DELLER has been made patent counsel for the International Nickel Co., Inc., 67 Wall St., New York City, and will head the newly created patent department of the company. Mr. Deller has been chief consultant on patent affairs for the International Nickel Co. for the last ten years.

HAROLD CAMINEZ has been appointed executive engineer of Air Associates, Inc., Garden City, N. Y. Mr. Caminez was connected with the Allison Engineering Co., Indianapolis, Ind., from 1929 to 1936. He originated the "Aero" screw thread system recently introduced by Air Associates, Inc.

GLENN G. BOBST has been appointed lighting specialist for the General Electric Co., with headquarters at Syracuse, N. Y. Mr. Bobst has been with the General Electric Co. since 1934. For the last four years, he has been engaged in the sales and promotion of lighting equipment.

A. GORDON KING has been appointed secretary of the Technical Section of the American Gas Association, 420 Lexington Ave., New York City. Mr. King has acted as service engineer for the Association for the last seventeen years.

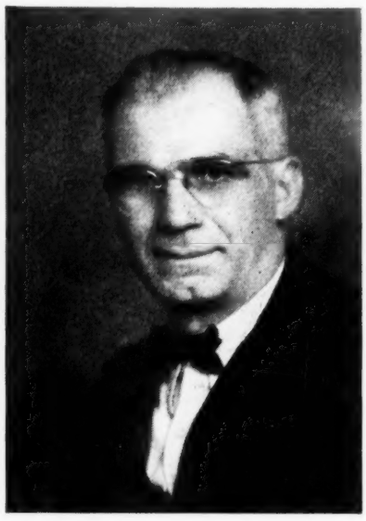
BAKELITE CORPORATION and HALOWAX CORPORATION announce that their offices have been moved from 247 Park Ave. to the Carbide and Carbon Bldg., 30 E. 42nd St., New York City.

R. VOLBRECHT has joined the New York merchandising sales staff of Cutler-Hammer, Inc., Milwaukee, Wis., manufacturer of safety switches, motor control, and allied equipment.

Ohio

EDWIN J. THOMAS has been elected president of the Goodyear Tire & Rubber Co., Akron, Ohio. Mr. Thomas was born in 1898, and began working for the Goodyear company as a part-time helper while attending high school. He has worked for the Goodyear organization ever since, successively as stenographer, secretary to the factory manager, manager of personnel, superintendent of the Los Angeles plant, assistant factory manager at Akron, general superintendent at Akron, managing director of the Goodyear British subsidiary in England, assistant to the president, and executive vice-president. P. W. LITCHFIELD, formerly president of the company, becomes chairman of the board.

CRAIG HAMPTON has been appointed superintendent of maintenance of the new plant of the Copperweld Steel Co., at Warren, Ohio. Mr. Hampton was previously connected with the Steel and Tube Division of the Timken Roller Bearing Co.



Craig Hampton, Superintendent of Maintenance of Copperweld Steel Co., at Warren, Ohio

G. V. PATRICK has been appointed director of sales for the Cleveland Automatic Machine Co., Cleveland, Ohio. Mr. Patrick, a graduate of the Massachusetts Institute of Technology, became connected with the company in 1928. For the last four years, he has been eastern sales manager, with offices at 50 Church St., New York City. H. A. GRAY, formerly connected with the U. S. Army Ordnance Department, succeeds Mr. Patrick as eastern sales manager. F. C. REESE has been appointed district sales manager, with offices at 314 American Bldg., Cincinnati, Ohio.

F. J. GEIGER has been appointed assistant manager of the electrical department of the Allis-Chalmers Mfg. Co., in which capacity he will be in complete charge of sales and engineering at the company's Norwood, Ohio, plant. Mr. Geiger succeeds C. J. RATTERMANN, whose resignation was reluctantly accepted after he had served the company for almost forty years. Mr. Geiger has been in the employ of the company since 1913.

GEORGE I. ALLEN, manager of the Heppenstall Co.'s Cleveland office, has retired. Mr. Allen, who joined the Heppenstall company in 1913, is being succeeded by his son, JACK R. ALLEN, a graduate in mechanical engineering of the Case School of Applied Science, class of 1934.

HYDRAULIC PRESS MFG. CO., Mount Gilead, Ohio, is building an entirely new plant for the manufacture of the company's hydraulic presses. The Austin Co., Cleveland, Ohio, is the architect and builder. The new plant is 400 feet long, arranged in three parallel bays.

ROY F. LAB has been engaged as chief chemist of the Copperweld Steel Co., at Warren, Ohio. Mr. Lab was previously connected with the United Alloy Steel Co., the Central Alloy Steel Co., the Republic Steel Co., and the Barium Stainless Steel Co.

WELDON TOOL CO., 3000 Woodhill Road, Cleveland, Ohio, announces that the company is now the exclusive manufacturer and distributor of the "Tu-Lip" counterbore, formerly made by the GOPHER MACHINE & TOOL WORKS CO., Minneapolis, Minn.

E. C. GEORGE, who has been acting as works manager of the Norwood, Ohio, plant of the Allis-Chalmers Mfg. Co., and A. THORSEN, who has been acting as assistant works manager, have both been appointed to permanently serve in those positions.

SPRINGFIELD ELECTRIC MOTOR CO., Springfield, Ohio, has been appointed a distributor for the GENERAL ELECTRIC Co., Schenectady, N. Y., for "Deltabeston" wires and cables, insulating and wiring materials, and automotive products.

JOHN R. HAYSAK has been elected vice-president in charge of factory management of the Ferry Cap & Set Screw Co., Cleveland, Ohio. Mr. Haysak has been with the company for over twenty-one years.

Pennsylvania

JOHN A. BROWN has retired from the Heppenstall Co., Pittsburgh, Pa., after having been with the company for forty years. For the last ten years, Mr. Brown has been special service representative for the company's shear knife business. HARRY E. REITH, formerly with Brooks Oil Co., will succeed Mr. Brown.

HERMAN J. HOFMANN, who has been assistant open-hearth superintendent of the Lukens Steel Co., Coatesville, Pa., since 1926, has been promoted to the position of open-hearth superintendent, succeeding J. D. WALTERS, who has resigned.

Whether

BIG

Machines

EX-CELL-O AUTOMATIC THREAD GRINDER (STYLE 33)

. . . or

SMALL

Tools

CONTINENTAL COUNTERBORE (SHOWING INDESTRUCTIBLE DRIVE)

. . . EVERY EX-CELL-O PRODUCT IS BUILT TO DO PRECISION WORK AT MINIMUM COST!

There's only one standard that's acceptable at Ex-Cell-O in the planning and making of machines and tools—the greatest degree of precision that it is humanly possible to attain . . . consistent with reasonable cost and practical production requirements. This is why the leaders in a fast increasing number of industries invariably turn to Ex-Cell-O to solve their problems of higher production, lower cost, greater precision.

EX-CELL-O CORPORATION
1212 OAKMAN BLVD., DETROIT, MICHIGAN

EX-CELL-O CORPORATION
1212 Oakman Blvd., Detroit, Mich.
Send me Ex-Cell-O General Products Folder (Bulletin No. 11383)

Name.....

Company.....

Address.....

XLO *Precision* THREAD GRINDING, BORING AND LAPPING MACHINES, TOOL GRINDERS, GRINDING SPINDLES, HYDRAULIC POWER UNITS, DIESEL INJECTOR PUMPS, BROACHES, CUTTING TOOLS, DRILL JIG BUSHINGS, ETC.

Frank H. Gordon, Vice-president in Charge of Sales of the Lukens Steel Co.

FRANK H. GORDON, vice-president in charge of sales of the Lukens Steel Co., Coatesville, Pa., celebrated his forty-fifth anniversary with the concern on July 25. He started as an office boy with the company in 1895. In 1903, he was made assistant general sales agent, and became general sales agent in 1907. He was elected vice-president in charge of sales in 1928.

NATIONAL MOLDED PRODUCTS, INC., 122 Mill St., St. Mary's, Pa., has been organized to manufacture self-lubricating bearings and other powdered metal products. The president of the company is W. L. STRAWBRIDGE.

GROSVENOR S. MCKEE, production manager of Talon, Inc., Meadville, Pa., has been elected a director of the Hall Planetary Co., Philadelphia, Pa., manufacturer of planetary milling machines.

LEON B. ROSSEAU, formerly industrial heating specialist for the General Electric Co., has joined the staff of the Ajax Electric Co., Inc., Philadelphia, Pa., and will serve in the capacity of district sales manager.

Wisconsin

M. A. CARPENTER has been elected executive vice-president and director of the Falk Corporation, Milwaukee, Wis. Mr. Carpenter has been associated with the Falk Corporation for the last sixteen years, serving successively as advertising manager, sales promotion manager, sales manager, and until his recent appointment, as secretary and director of sales. He will continue to be active as director of sales and advertising, in addition to filling his duties as executive vice-president.

CHAIN BELT CO., Milwaukee, Wis., has just completed moving the manufacturing operations of its screw conveyor and light steel bucket divisions from its Chicago plant to the West Milwaukee works of the company.

CLINTON E. STRYKER has been appointed vice-president and assistant to the president of the Nordberg Mfg. Co., Milwaukee, Wis. Mr. Stryker was formerly a partner in McKinsey, Kearney & Co., management engineers, of Chicago, having been with that firm for five years. He is a graduate of the Armour Institute of Technology, class of 1917.

Clinton E. Stryker, Vice-president and Assistant to President of the Nordberg Mfg. Co.

COMING EVENTS

SEPTEMBER 3-6—Fall meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Spokane, Wash. Further information may be obtained by addressing C. E. Davies, secretary, 29 W. 39th St., New York City.

SEPTEMBER 18-20—Eighteenth annual conference of the NATIONAL INDUSTRIAL ADVERTISERS ASSOCIATION to be held at the Hotel Statler, Detroit, Mich. For further information, address National Industrial Advertisers Association, Inc., 100 E. Ohio St., Chicago, Ill.

SEPTEMBER 24-25—NATIONAL TRACTOR MEETING OF THE SOCIETY OF AUTOMOTIVE ENGINEERS at Schroeder Hotel, Milwaukee, Wis. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

SEPTEMBER 24-27—Convention and Exposition of the ASSOCIATION OF IRON AND STEEL ENGINEERS at the Hotel Stevens, Chicago, Ill.

SEPTEMBER 26-29—Seventeenth annual convention of the NATIONAL ASSOCIATION OF FOREMEN at the Hotel Gibson, Cincinnati, Ohio. H. G. Evans, Goodyear Tire & Rubber Co., Akron, Ohio, secretary.

OCTOBER 7-11—NATIONAL SAFETY CONGRESS AND EXPOSITION to be held at the Stevens Hotel, Chicago, Ill., under the auspices of the National Safety Council, 20 N. Wacker Drive, Chicago, Ill.

OCTOBER 8-12—SOUTHERN POWER AND ENGINEERING SHOW in the Armory Auditorium, Charlotte, N. C. For further information, address Junius M. Smith, vice-president, Southern Power and Engineering Show, Inc., P. O. Box 1225, Charlotte, N. C.

OCTOBER 14-16—Twenty-third semi-annual meeting of the AMERICAN GEAR MANUFACTURERS ASSOCIATION to be held at Skytop Lodge, Skytop, Pa. J. C. McQuiston, manager-secretary, 602 Shields Bldg., Wilkinsburg, Pa.

OCTOBER 17-19—Semi-annual meeting of the AMERICAN SOCIETY OF TOOL ENGINEERS at the Hotel Gibson, Cincinnati, Ohio. Ford R. Lamb, executive secretary, 2567 W. Grand Blvd., Detroit, Mich.

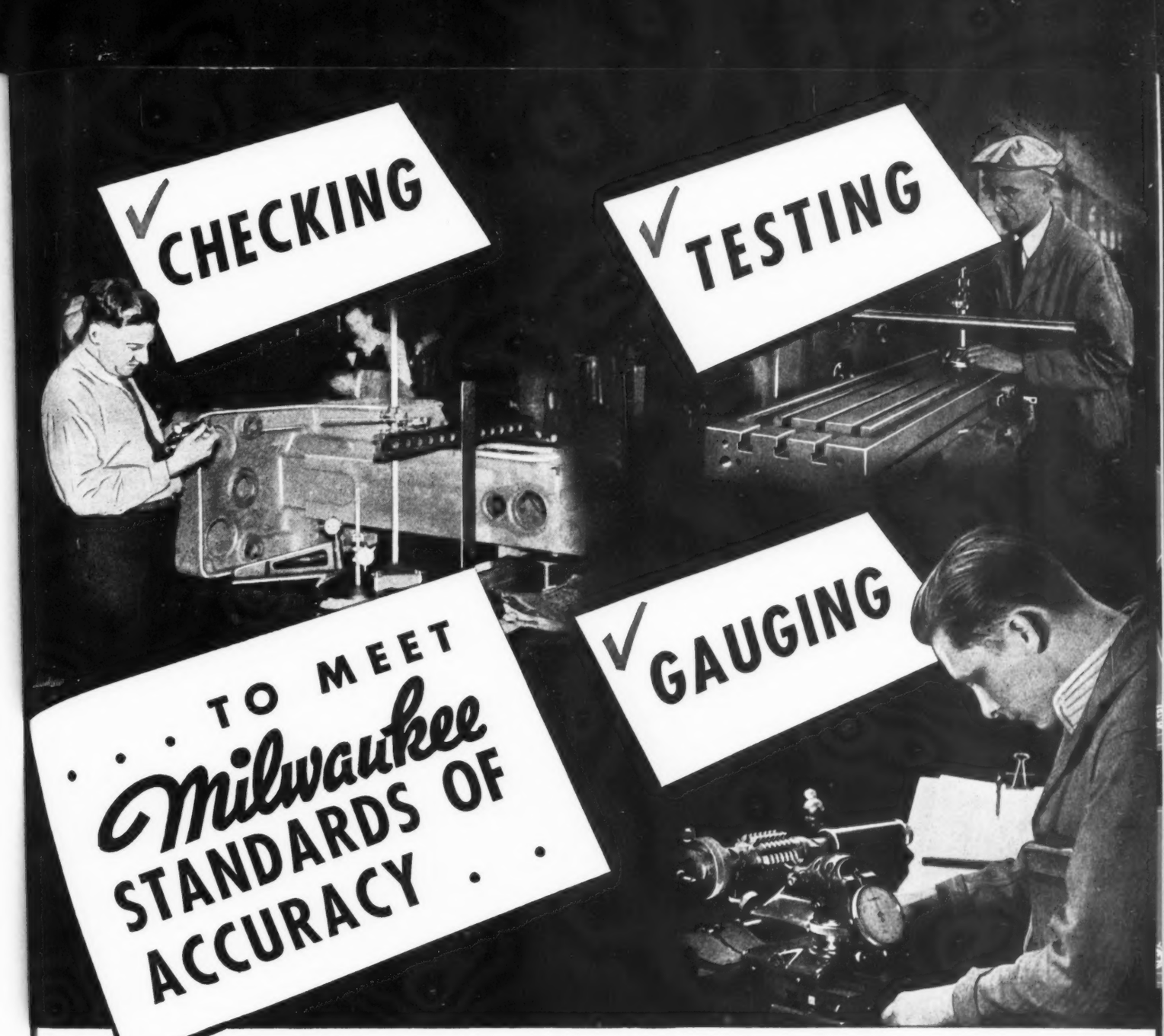
OCTOBER 21-25 — NATIONAL METAL EXPOSITION, to be held at Cleveland, Ohio, under the auspices of the American Society for Metals. W. H. Eisenman, secretary, 7301 Euclid Ave., Cleveland, Ohio.

OCTOBER 31-NOVEMBER 2—National Aircraft Production Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Hotel Biltmore, Los Angeles, Calif. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

NOVEMBER 8-9—NATIONAL TIME AND MOTION STUDY CLINIC to be held at the Chicago Towers Club, Chicago, Ill., under the auspices of the Industrial Management Society. For further information, address W. F. Entorf, Industrial Management Society, 205 W. Wacker Drive, Chicago, Ill.

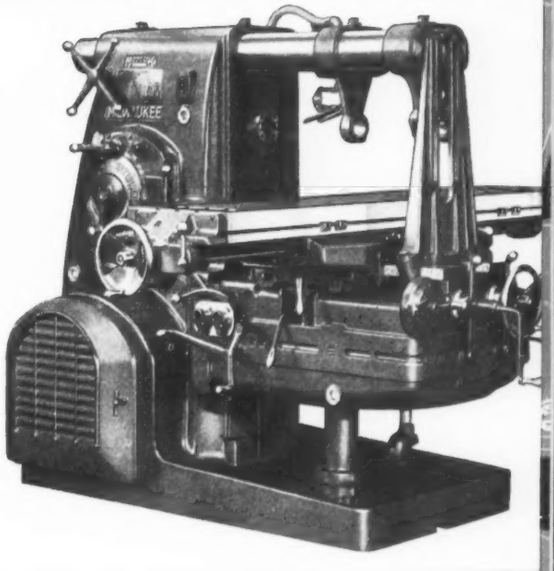
DECEMBER 2-5—Annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in New York City. C. E. Davies, secretary, 29 W. 39th St., New York City.

DECEMBER 2-7 — Fourteenth NATIONAL EXPOSITION OF POWER AND MECHANICAL



A LARGE staff of highly trained technical men — constantly checking, testing, and gauging at every stage of construction and assembly — make sure that every part — every unit — measures up to Milwaukee standards of milling machine quality and accuracy.

KEARNEY & TRECKER CORPORATION
MILWAUKEE, WISCONSIN



Milwaukee MILLING MACHINES

ENGINEERING to be held at the Grand Central Palace, New York City. For further information, address International Exposition Co., Grand Central Palace, New York City.

JANUARY 6-10, 1941—Annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at Book-Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

MARCH 24-29, 1941—MACHINE AND TOOL PROGRESS EXHIBITION at Convention Hall, Detroit, Mich., under the auspices of the American Society of Tool Engineers, 2567 W. Grand Blvd., Detroit, Mich.

OBITUARIES

Stanley P. Rockwell

Stanley P. Rockwell, president of the Stanley P. Rockwell Co., Hartford, Conn., was killed August 11 by an explosion on his yacht at Middletown, Conn. Mr. Rockwell was well known in the metallurgical field as the inventor of the Rockwell hardness testing machine.

In 1912, Mr. Rockwell became connected with the New Departure organization at Bristol, Conn., as a chemist in the metallurgical laboratory, where the research began that resulted in the development of the Rockwell hardness tester, originally designed for use on New Departure ball bearings. From 1913 to 1915, he was in charge of heat-treating at the Elmwood plant of the company, and in 1915 he returned to Bristol. During the war, he was a captain in the Ordnance Department, in charge of inspection. At the close of the war, he became associated with the Whitney Chain & Mfg. Co., and shortly afterward he organized the New England Heat-Treating Service Co. which later became the Stanley P. Rockwell Co., with a plant on Homestead Ave., Hartford.

In 1939, Mr. Rockwell's achievements in metallurgy and in the development of the Rockwell hardness tester were recognized by the conferring upon him of the Sauveur medal of the American Society for Metals.

CHARLES H. HELLER, chairman of the board of the Bower Roller Bearing Co., Detroit, Mich., died suddenly on July 26. Mr. Heller was born in Dayton, Ohio, in 1875, and was one of the organizers of the Bower Roller Bearing Co., joining with R. F. Bower in incorporating the company and establishing the first factory in Dayton in 1907. In 1910, Detroit automotive leaders were influential in bringing the company to Detroit. Mr. Heller became secretary and treasurer of the company at the time it was organized, and served in that office until 1924, when he became president. In 1932, he became chairman of the board, an office that he retained until his death.

WILLIAM HENRY HARRINGTON, eastern sales manager of the New Departure Division of General Motors Corporation, Bristol, Conn., died July 13, following an operation, at the age of forty-eight years. Mr. Harrington became connected with the organization as an engineer, and in 1917 was made chief engineer. In 1921, he joined the Arrow-Hart & Hegeman Co., Hartford, Conn., but returned to the New Departure organization in 1934 in the capacity of eastern sales manager.

JOHN LOWELL FYKE, general superintendent of the electrical and steam turbine shops of the Allis-Chalmers Mfg. Co., West Allis Works, since 1935, died suddenly at his home on July 24 at the age of fifty-five years. Mr. Fyke was a graduate of the Engineering School of the Ohio State University, and since 1905 has been connected with the Allis-Chalmers organization.

DONALD M. SMITH, assistant district sales manager of the Allegheny Ludlum Steel Corporation at Chicago, died at his home in Palos Park, Chicago, on June 21. Prior to the merger of the Allegheny and Ludlum organizations, Mr. Smith was district sales manager of the Allegheny Steel Co.

FRED C. REIF, secretary of the Boye & Emmes Machine Tool Co., Cincinnati, Ohio, died July 23, after many years of association with the company.

NEW BOOKS AND PUBLICATIONS

LESSONS IN ARC WELDING. 144 pages, 6 by 9 inches; over 100 illustrations. Published by the Lincoln Electric Co., Cleveland, Ohio. Price, 50 cents in the United States; 75 cents abroad.

This book, which contains fifty-one specific lessons in arc welding, will be found helpful not only by beginners who are learning to weld, but also by experienced welders who wish to obtain comprehensive practical information and by supervisors, foremen, and instructors desiring a ready reference book of fundamental information on arc welding and its applications. The book is based upon the experience of Arthur Madson, instructor of the Lincoln Arc Welding School. The fundamental facts on welding are presented in a concise manner that makes it possible to absorb all the facts that it contains with minimum effort.

The book begins with an introduction giving preliminary instruction to the welder—including suggestions as to how to learn most easily the fundamental principles of arc welding. Attention is called to the need for continual practice, and points are given on how to examine welds, how to criticize and invite criticism of work done, etc. The fifty-one lessons are covered in four principal sections: Welding with unshielded arc electrodes; welding with shielded arc electrodes; electrodes for particular joints and metals; and hard-facing. The explanations in the text are supplemented by clear and simple drawings, as well as by photographs. A useful addition to the book consists of a series of questions on each of the lessons, enabling the student to check his knowledge.

SCIENTIFIC PRICE MANAGEMENT—I. By Allen W. Rucker. 22 pages, 12 by 9 inches; six charts. Published by the Eddy-Rucker-Nickels Co., Cambridge, Mass. Price, $5.

This publication, which is mimeographed from typewritten copy, except for the charts which are reproduced in color printing, has been prepared especially for those who have pricing decisions to make—executives, sales managers, production managers, auditors, etc. Fifteen different types of pricing problems, taken from actual case studies by the author's firm, give the user of the manual a guide to pricing problems. The case studies range from simple "price cuts" to problems involving advertising allowances, freight allowances, and sales bonuses. In addition, problems dealing with added production required of factory employes to justify step-up differential piece-rates, and similar problems, are covered.

The author, who is president of the Eddy-Rucker-Nickels Co., counselor on marketing, sales and advertising, has included six calculator charts, printed in two colors on index bristol board and bound into the manual. The author states that he has attempted to produce not so much a book as a working manual for executives, and one that can be used constantly by those who have to make decisions relative to prices and costs. The compilation is bound in hard covers with plastic binding.